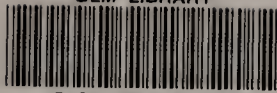


BLM LIBRARY



88074175

DRAFT ENVIRONMENTAL IMPACT STATEMENT

COAL

GREEN RIVER - HAMS FORK REGION

ROUND TWO



United States Department of the Interior

IN REPLY REFER TO:

1792
3220
(161)

BUREAU OF LAND MANAGEMENT
COLORADO STATE OFFICE
1037 20th STREET
DENVER, CO 80202

Dear Reader:

Enclosed for your review and comment is the Green River/Hams Fork Coal Region Round Two Draft Environmental Impact Statement (EIS), prepared by the Bureau of Land Management.

Public hearings on the Draft EIS have been scheduled in the following communities:

September 12, 1983
Ramada Inn Foothills
11595 W. Sixth Avenue
Denver, Colorado
1:30 p.m. and 7:00 p.m.

September 13, 1983
BLM-Rawlins District Office
1300 N. Third Street
Rawlins, Wyoming
7:30 p.m.

September 14, 1983
Holiday Inn
1675 Sunset Drive
Rock Springs, Wyoming
7:00 p.m.

September 15, 1983
Craig-Moffat County Library
570 Green Street
Craig, Colorado
7:00 p.m.

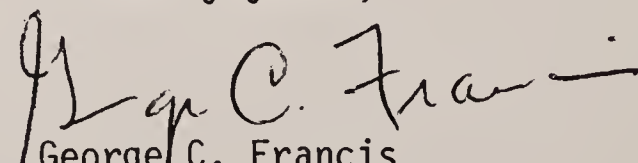
Comments on the Draft EIS may be presented orally at the public hearings or submitted in writing. In order to be considered in the Final EIS, all comments must be received by October 7, 1983. Written comments should be sent to:

Carol MacDonald, Team Leader
Bureau of Land Management
Little Snake Resource Area
P. O. Box 1136
Craig, Colorado 81626

Please keep this Draft EIS to be used in conjunction with the Final EIS. If only minor modification is required as a result of review and comment, the final statement will incorporate this document by reference, with any necessary modifications and corrections, a record of public comments, and the responses to these comments.

Thank you for your interest in the Federal coal management program.

Sincerely yours,


George C. Francis
State Director

Enclosure

ERRATA
for the Draft Green River-Hams Fork
Environmental Impact Statement

Federal lands within the Corral Canyon tract have very recently been included in a land exchange. Since the lands are now in private ownership they will not be part of the Department of Interior's coal leasing process.

The Final Green River-Hams Fork Environmental Impact Statement will reflect any necessary changes in analysis, or presentation of material, resulting from the exchange.

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

Trying to set up
RCT meeting Oct 17-28
#9906149

GREEN RIVER/HAMS FORK REGIONAL COAL EIS II
FEIS PREPARATION SCHEDULE

ID: 88074175

8/10/83

HD
243
-W9
G744
1993
C.2

DEIS Public Comment Period	8/9 - 10/7/83
DEIS Public Hearings <i>Sep. 14 Holiday Inn</i>	09/12 - 9/15
Team Leader/Tech. Coord. review comments, identify substantive comments	09/26 - 10/12
Team prepares draft responses to comments and any necessary text changes	10/03 - 10/21
WO reviews comments in Denver	10/21*
Tech. Coord. reviews draft responses and text changes	10/17 - 10/28
Team revises responses, text changes;	
Tech. Coord. compliance reviews	10/24 - 11/04
Editor assembles PFEIS	11/05 - 11/12
Transmit PFEIS to Craig, Rock Springs, and Rawlins Districts, Wyo. SO, and Colo. SO	11/13
Districts/SO's review PFEIS	11/14 - 11/16
Close-out in Craig	11/17
Team/Tech. Coord./Editor incorporate changes	11/18 - 11/27
Editor finalizes PFEIS	11/28 - 12/02
Submit PFEIS to WO	12/5**
WO (policy) review of PFEIS	12/5 - 12/16*
Team/Tech. Coord./Editor incorporate changes	12/19 - 12/30
Editor assembles FEIS	1/3 - 1/8
Transmit FEIS to Wyo. SO and Colo. SO for compliance review	1/9
Editor codes FEIS for typesetting	1/9 - 1/13
SO's review FEIS	1/10 - 1/11
Team/Tech. Coord./Editor incorporate changes, finalize FEIS	1/12 - 1/19
Submit FEIS to WO	1/20/84*
WO compliance review of FEIS	1/23 - 1/27*
Editor/Cartographer prepare camera-ready copy	1/30 - 2/3
Print FEIS	2/6 - 2/17
File FEIS with EPA	2/24*

may need to
go to Craig
to discuss
comments
Oct 17-21

*WO MBO dates

**Current WO MBO date = 12/7

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

#9906149

ID: 83074175

HD
243
.W8
G744
1983
C.2

GREEN RIVER - HAMS FORK
COAL REGION

ROUND TWO
DRAFT ENVIRONMENTAL IMPACT STATEMENT

Prepared by
THE DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

Bol Moore Acting
COLORADO STATE DIRECTOR

GREEN RIVER-HAMS FORK
REGIONAL COAL
ENVIRONMENTAL IMPACT STATEMENT
ROUND II

Draft (X) Final ()

The United States Department of Interior, Bureau of Land Management, in cooperation with the Office of Surface Mining Reclamation and Enforcement

1. *Type of Action:* Administrative (X) Legislative ()

2. *Abstract:* The cumulative impacts of developing up to 24 coal tracts through four leasing alternatives in northwest Colorado and southwest and south-central Wyoming are analyzed. The four leasing alternatives propose offering for lease 101, 495, 759, or 991 million tons of coal recoverable by surface, subsurface, or in situ gasification mining methods. The significant, and unquantifiable but potentially significant, impacts to human and biological resources are analyzed by considering the impacts that existing and future growth and development in the region could have (baseline), together with the impacts of the four leasing alternatives. Impacts increase in number and magnitude as the amount of coal to be developed increases through the alternatives. However, the number and magnitude of impacts can be influenced by which of the 24 tracts are included in a particular alternative, except for the maximum leasing alternative, which includes all tracts to be leased.

3. *Comments have been requested from the following:* See Chapter 5, Consultation and Coordination

4. *For further information, contact:*

Carol A. MacDonald, Team Leader
Bureau of Land Management
Little Snake Resource Area
P.O. Box 1136
Craig, Colorado 81626
Telephone: (303) 824-4441

5. Comments on the draft statement must be received no later than: October 7, 1983

6. Date filed with EPA

Draft

Final

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

TABLE OF CONTENTS

Summary	xi	Analysis Assumptions and Guidelines	121
CHAPTER 1: PURPOSE AND NEED FOR THE PROPOSED ACTION	1	Air Quality	122
Background Information.....	1	Geology, Topography, and Minerals.....	125
Public Scoping	3	Soils.....	129
Issues.....	3	Water Resources.....	133
Authorities for Coal Leasing and Development.....	5	Vegetation.....	154
Time Frames.....	5	Animal Life.....	158
CHAPTER 2: DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION	7	Cultural Resources	171
Introduction.....	7	Recreation, Visual, and Wilderness Resources	172
Description of Alternatives.....	7	Land Use	178
Mitigation Requirements.....	28	Economics	183
Comparison of Alternatives.....	29	Social Impacts.....	202
CHAPTER 3: AFFECTED ENVIRONMENT	39	Transportation	212
Introduction.....	39	Net Energy Analysis	223
Climate and Air Quality	39	CHAPTER 5: PUBLIC PARTICIPATION	225
Geology, Topography, and Minerals.....	51	Introduction	225
Soils.....	56	Distribution of Draft EIS	225
Water Resources.....	57	List of Preparers	226
Vegetation.....	65	APPENDICES.....	229
Animal Life.....	71	Appendix 1: Tract Ranking Factors and Subfactors.....	229
Cultural Resources	85	Appendix 2: Summary of Individual Tracts.....	233
Recreation, Visual, and Wilderness Resources	90	Appendix 3: Economics Data	255
Land Use	93	Appendix 4: Vegetation Analysis Methodology	265
Economics	95	Appendix 5: Predicted Annual Average Air Pollutant Concentrations	267
Social Environment.....	103	Appendix 6: Mitigation Requirements	277
Transportation	109	GLOSSARY	287
CHAPTER 4: ENVIRONMENTAL CONSEQUENCES	121	REFERENCES.....	289
Introduction	121		

TABLES

Chapter 2

2-1	Baseline Projects and Acreage Disturbance Totals	9
2-2	Tracts Proposed for Leasing Under the Five Alternatives	12
2-3	Surface and Mineral Estate Acreage	14
2-4	Low Leasing Alternative Mineral Resource Values	15
2-5	Moderate Leasing Alternative Mineral Resource Values	16
2-6	High Leasing (Preferred) Alternative Mineral Resource Values	17
2-7	Maximum Leasing Alternative Mineral Resource Values	18
2-8	Low Leasing Alternative Acres Disturbed	19
2-9	Moderate Leasing Alternative Acres Disturbed	20
2-10	High Leasing (Preferred) Alternative Acres Disturbed	21
2-11	Maximum Leasing Alternative Acres Disturbed	22
2-12	Low Leasing Alternative Transportation and Employment	23
2-13	Moderate Leasing Alternative Transportation and Employment	24
2-14	High Leasing (Preferred) Alternative Transportation and Employment	25
2-15	Maximum Leasing Alternative Transportation and Employment	26
2-16	Comparison of Impacts for Northwest Colorado Subregion	30
2-17	Comparison of Impacts for South-Central Wyoming Subregion	31
2-18	Comparison of Impacts for Southwest Wyoming Subregion	32
2-19	Comparison of Impacts by Alternative	33
2-20a	Northwest Colorado Subregion Impacts by Tract	34
2-20b	Northwest Colorado Subregion Impacts by Tract	35
2-21	Southcentral Wyoming Subregion Impacts by Tract	36
2-22	Southwest Wyoming Subregion Impacts by Tract	37

Chapter 3

3-1	Selected Climatic Data	40
3-2	Selected Atmospheric Dispersion Values	42
3-3	State and Federal Air Quality Standards	44
3-4	Selected Ambient Pollutant Concentration Data	46
3-5	Selected Visual Range Data	48
3-6	Selected Atmospheric Precipitation Data	49
3-7	Hydrologic Data for Some Streams Draining Coal Areas	59
3-8	Hydrologic Data for Some Streams Draining Mountain Areas	60
3-9	Major Coal Region River Basins	61
3-10	Water Bearing Formations in Northwestern Colorado: Yampa and White River Basins	64
3-11	Water Bearing Formations in Southwestern and Southcentral Wyoming: North Platte and Green River	66
3-12	Vegetation Types	67
3-13	Key Wildlife Species in the Habitat Analysis Area	74
3-14	Relative Values of Habitat Types to Wildlife	75
3-15	Key Species Occurrence and Abundance	76
3-16	Threatened and Endangered Wildlife in the Habitat Analysis Area	84
3-17	Known Cultural Resources	86
3-18	Archaeological Site Types	87
3-19	Historic Site Types	88
3-20	Chronology of EIS Region	89
3-21	Surface Ownership by County and tract	94
3-22	Available AUMS/Year by County and Tract	96
3-23	Existing Land Use by County	97

3-24	1980 Employment and Income	99
3-25	1980 Population	100
3-26	1980 Housing Units	101
3-27	1980 Agricultural Earnings	102
3-28	Local Government Financial Data	104
3-29	Social Impacts: Portrait of a Boomtown	110
3-30	Social Components and Readiness for Additional Growth: Study Area Communities	111
3-31	Affected Colorado Highways	118
3-32	Affected Wyoming Highways	119
3-33	Noise Levels for Affected Highways	120

Chapter 4

4-A	Selected "Worst-Case" Regional Total Suspended Particulate Concentrations	124
4-1	Soil Disturbance	130
4-R	Potential Reclamation Problems	132
4-2	Number of Wells, Springs, and Reservoirs that Could Be Impacted at the Various Alternative Levels	135
4-3	Estimated Annual Water Balance for the North Platte River at Orin, Wyoming Without Leasing New Federal Coal	136
4-4	Estimated Annual Water Balance for the White River at the Colorado/Utah Stateline Without Leasing New Federal Coal	137
4-5	Estimated Annual Water Balance for the Green River at Flaming Gorge Near Linwood, Utah Without Leasing New Federal Coal	138
4-6	Estimated Annual Water Balance for the Yampa River Near Maybell, Colorado Without Leasing New Federal Coal	138
4-7	Summary Matrix of Annual Water Balance and Water Quality at Maximum Development at the Year 2000	140
4-8	Estimated Water Quality for the North Platte River Without Leasing New Federal Coal	142
4-9	Estimated Water Quality for the Yampa River Without Leasing New Federal Coal	143
4-10	Estimated Water Quality for the Green River Without Leasing New Federal Coal	144
4-11	Estimated Water Quality for the White River Without Leasing New Federal Coal	145
4-12	Sediment Yield at the Year 2000	147
4-13	Removal of Aquifers by Leasing New Federal Coal at Maximum Development (end of mine life)	149
4-14	Summary of Flood Plains and Alluvial Valley Floors	153
4-15	Projected Vegetation Disturbances under No Action	156
4-16	Maximum Alternative Plus Baseline [Vegetation Disturbance]	157
4-17	Estimated Animal Habitat Losses	160
4-18	Estimated Animal Losses Due to Habitat Loss	162
4-19	Estimated Animal Losses Due to Other Human Causes in Colorado	164
4-20	Estimated Animal Losses Due to Other Human Causes in Wyoming	165
4-21	Summary of Unavoidable Adverse Impacts on Colorado Wildlife	168
4-22	Summary of Unavoidable Adverse Impacts on Wyoming Wildlife	169
4-23	Visual Resource Analysis for Proposed Lease Areas	176
4-24	Loss of Animal Unit Months Per Year	180
4-25	Employment Impacts - Moffat County	185
4-26	Population Impacts	192
4-27	New Housing Requirements	195

4-28	Direct Mine Taxes	199
4-29	Baseline Growth	203
4-30	Annual Community Growth - Low Alternative	205
4-31	Annual Community Growth - Moderate Alternative	205
4-32	Annual Community Growth - High Alternative	207
4-33	Annual Community Growth - Maximum Alternative	209
4-34	Capacity Utilized for Colorado Road Segments	213
4-35	Capacity Utilized for Wyoming Road Segments	214
4-36	Traffic Increases.	216
4-37	Accident Projections for Colorado Road Segments.	217
4-38	Accident Projections for Wyoming Road Segments	218
4-39	Trended Noise Levels for Colorado & Wyoming Highways: No Action Alternative	221
4-40	Increase in Noise Levels for Colorado & Wyoming Highways: Maximum Alternative	222
4-41	Net Energy Summary	224

Appendix 1

A1-1	Tract Ranking by Regional Coal Team	230
------	---	-----

Appendix 2

A2-1	Leasing Scenarios Analyzed in Site Specific Analyses	234
------	--	-----

Appendix 3

A3-1	Impacts on Bonding Capacity and Capital Improvements	257
------	--	-----

Appendix 5

A5-1	Project Operation and Emission Assumptions for Proposed Lease Tracts	275
A5-2	Predicted "Worst-Case" Maximum Tract Specific Total Suspended Particulate Concentrations	276

MAPS

Chapter 1

1-1	Location Map	2
-----	------------------------	---

Chapter 3

3-1	Wildlife Habitat Analysis Area	72
3-2	Elk and Moose Analysis Areas	80
3-3	Deer Analysis Areas	81
3-4	Pronghorn Antelope Analysis Areas.	83
3-5	Relationships of Towns, Tracts, and Highways	106
3-6	Major Transportation Routes.	116

FIGURES

Chapter 2

2-1	Projected Annual Baseline Coal Production for Colorado	10
2-2	Projected Annual Baseline Coal Production for Wyoming	11
2-3	Projected Annual Cumulative Coal Program	13

Chapter 3

3-1	Surface Wind Roses	41
3-A	Air Quality Monitoring Locations and Sensitive Areas	50
3-2	Generalized Tectonic Map Showing Location of Green River- Hams Fork Coal Lease Tracts	52
3-3	Stratigraphic Nomenclature and Correlative Chart for Green River- Hams Fork Coal EIS Region	54
3-4	Model of Population Impacts on a Community from Coal Development	108

Appendix 5

A5-1 - A5-7	Predicted Annual Average Air Pollutant Concentrations	282
-------------	---	-----

SUMMARY

This Draft Environmental Impact Statement (EIS) analyzes the environmental impacts of the proposed competitive leasing of 24 Federal coal lease tracts in the Green River-Hams Fork Coal Region. This is the second round of proposed Federal coal leasing in the region.

As part of the Federal coal management program, the Department of the Interior, through the Bureau of Land Management, periodically conducts competitive coal lease sales to ensure that adequate coal supplies are available to meet national long-term energy requirements and to ensure that adequate reserves are available to continue existing production. In accordance with this program, on January 6, 1983, the Secretary of the Interior established a leasing level range of 750 to 950 million tons of recoverable coal for this second round of leasing in the Green River-Hams Fork Coal Region.

The Green River-Hams Fork Coal Region encompasses all or portions of Albany, Carbon, Sweetwater, Sublette, Lincoln, and Uinta counties in Wyoming and Routt, Moffat, Jackson, Grand, and Rio Blanco counties in Colorado. However, the proposed Federal leasing would affect primarily Carbon County in southcentral Wyoming, Sweetwater and Uinta counties in southwest Wyoming, and Routt, Moffat, and Rio Blanco counties in northwest Colorado.

Issues/Areas of Controversy

A preliminary set of issues and alternatives was presented to the public for review and comment in January 1983. No new alternatives or issues within the scope of the EIS were identified during the public scoping process, but existing issues were elaborated on, with concerns on specific areas or resource conflicts being raised. Major areas of concern or controversy raised during the public scoping period centered around the following issues: air quality, water quantity and quality, wildlife values, reclamation potential, land use (particularly impacts to ranching operations), wilderness/recreation areas, transportation of coal, economics, and social values.

Alternatives

Five alternatives are addressed in this EIS: No Action, Low Leasing, Moderate Leasing, High Leasing (agency preferred alternative), and Maximum Leasing. The leasing alternatives include various

mitigation requirements, which are considered part of the proposed Federal actions under all alternatives.

The No Action alternative would not offer for competitive leasing any of the 24 tracts, except for Little Middle Creek (in Colorado), which could qualify as an emergency bypass lease. However, even without new Federal leasing, activities would occur as a result of both coal and noncoal actions, natural population growth, and continuation of some existing operations. Taken together, these activities constitute the baseline, which is a projection of overall development trends until the year 2000 without any additional Federal coal leasing.

The Low Leasing alternative proposes the leasing of seven tracts--four in southwest Wyoming and three in northwest Colorado (including Little Middle Creek). The tracts include a total of 341.2 million tons of in-place coal reserves, of which 101.1 million tons would be recoverable.

The Moderate Leasing alternative proposes leasing a total of 13 tracts--the 7 proposed under the Low Leasing alternative plus 1 additional tract in southwest Wyoming, 2 additional tracts in northwest Colorado, and 3 tracts in southcentral Wyoming. The 13 tracts include 1,276.8 million tons of in-place coal reserves, of which 495.3 million tons would be recoverable.

The High Leasing alternative proposes leasing a total of 19 tracts--the 13 proposed under the Moderate Leasing alternative plus 2 tracts in southwest Wyoming, 1 tract in southcentral Wyoming, and 3 tracts in northwest Colorado. The 19 tracts include 1,924.7 million tons of in-place coal reserves, of which 759.3 million tons would be recoverable. This figure falls within the Secretary's preliminary leasing level of 750 to 950 million tons, and this alternative is the preferred alternative.

The Maximum Leasing alternative proposes leasing all 24 tracts. This involves leasing 5 tracts in addition to those proposed under the High Leasing alternative--1 tract in southcentral Wyoming and 4 tracts in northwest Colorado. The 24 tracts include 2,449.9 million tons of in-place coal reserves, of which 990.7 million tons would be recoverable.

Major Conclusions

Analysis indicates that new Federal coal leasing would cause no significant impacts to the following resources under any alternative: climate, cultural or historical values, threatened or endangered species

SUMMARY

(on the tracts), flood plains, wetlands, prime or unique farmlands, areas of critical environmental concern (ACECs), wild and scenic rivers, wilderness areas, or wilderness study areas.

Resource categories which would incur one or more significant impacts from new coal leasing are air quality, geology/topography/minerals, water, vegetation, wildlife, recreation, visual resources, land use, economics, social values, and transportation.

Most of these resource categories would be significantly impacted under all four leasing alternatives, with overall impacts increasing in number and magnitude from the Low to the Maximum alternative as more tracts and greater total tonnages were incorporated. All impacts would occur under the Maximum alternative, since this alternative contains all tracts. The extent and magnitude of impacts on specific resources can be influenced by which of the 24 tracts are included in a particular alternative (except for the Maximum alternative). For example, certain tracts cause more impacts to particular wildlife habitats and species, others have lower reclamation potential, and still others create greater economic impacts (beneficial or adverse).

In general, the impacts tend to fall into three categories--regional, subregional, and local.

There are only two projected impacts of the proposed leasing which are clearly regional impacts: (1) increased salinity of the Colorado River (which could exceed adopted standards in the baseline) and (2) increased loss of life and property as a result of increased traffic accidents. The first impact is significant under (1) the No Action alternative (962 milligrams per liter total by the year 2000) and (2) the Maximum Leasing alternative (962.06 milligrams per liter due to cumulative contributions from all Colorado and southwest Wyoming tracts and one southcentral Wyoming tract). Under any other leasing alternatives, contributions of new coal leasing to Colorado River salinity would be so small as to be unquantifiable. The second regional impact cannot be quantified but is assumed to be potentially significant anywhere it occurs under any alternative.

Although the other impacts do occur throughout the region, they tend to be subregional or local in extent and magnitude. Their effects would tend to be felt primarily in one or more of the three major subregions--southwest Wyoming, southcentral Wyoming, or northwest Colorado; within the vicinity of a particular tract; or, in some cases, within a particular county or community.

Impacts which are clearly related only to specific tracts include:

- Potential for exceeding air quality standards (Cumulative 24-hour concentration of total suspended particulates of 147, 154, and 155 micrograms per cubic meter on Leucite Hills, Peck Gulch, and Fish Creek tracts, respectively; of these, 102 micrograms per cubic meter on Leucite Hills, 74 micrograms per cubic meter on Peck Gulch, and 65 micrograms per cubic meter on Fish Creek would be due to new Federal coal leasing. Annual sulfur dioxide concentrations of 48 micrograms per cubic meter on the Indian Springs Tract, from new Federal coal leasing)
- Alterations to topography (Tract 98)
- Conservation of coal resource (potentially unrecoverable surface mineable coal amounting to 28 million tons on Northeast Cow Creek and 19 million tons on Lay Creek)
- Unquantifiable decreases in water quality in Fish and Trout creeks (Middle Creek, Little Middle Creek, Fish Creek tracts) and Albert Creek (Byrne Coal Tract)
- Disturbance of raptor nests off tract (Lay Creek, Leucite Hills, and Atlantic Rim)
- Local disturbance of sage grouse nesting and brood-rearing habitat (Atlantic Rim and Corral Canyon tracts)
- Unquantifiable loss of riparian habitat (Atlantic Rim, Corral Canyon, Wild Horse Draw and Byrne Creek tracts)
- Potential loss of ranching operations (Pio and Williams Fork Mountain tracts)
- Reduction of Visual Resource Management Class II to Class III (Atlantic Rim Tract)
- Increased noise and traffic on Colorado State Highways 40 and 13 (Bell Rock Tract)

The remainder of the potentially significant impacts are generally subregional in extent. The following impacts tend to fall into this category:

- Increased salinity of the Green River (cumulative total salinity of 1,017.76 milligrams per liter by the year 2000, of which 1.76 milligrams per liter would be due to new Federal coal leasing)
- Unquantifiable decreases in groundwater quality
- Loss of big game winter habitat (cumulatively 360,000 acres by end of mine life in Northwest Colorado and Southwest Wyoming, of which 50,800 acres would be due to new Federal leasing)
- Cumulative losses of 2,300 elk (Northwest Colorado) and 6,700 mule deer (Northwest Colorado and Southwest Wyoming) by end of mine life; of these, 1,400 elk and 2,100 mule deer would be lost due to new Federal leasing. Unquantifiable losses of antelope (Southwest Wyoming)

SUMMARY

- Shortage of urban recreation facilities (parks, etc.) in Craig, Colorado, and Rock Springs and Rawlins, Wyoming
- Between 10 to 20 percent increases in employment and income in Moffat and Carbon counties
- Inadequate housing and social services at Meeker, Craig, Hayden, and Oak Creek, Colorado, and South Superior, Wyoming
- Heavy increased traffic in and near Craig, Colorado, and Sinclair, Rawlins, and Rock Springs, Wyoming. Heavy increased traffic on Moffat County Roads 17, 30, 33, and 47; Routt County Roads 27, 53, 59, and 61; Seminole Road and 20-Mile Road in Carbon County; and Sweetwater County Roads 4-15, 4-18, and 4-76.

Under the lower leasing-level alternatives, these impacts tend to be local. However, because these impacts are to some extent associated with many different tracts, cumulatively they may be subregional, depending on the impact and the subregion. Some of the impacts included in this category are subregional in one subregion and local in another subregion.

Other Actions

After release of the Final EIS in February 1983, the Regional Coal Team will recommend to the Director of the Bureau of Land Management (1)

which, if any, of the 24 tracts should be offered for lease sale and (2) if appropriate, a lease sale schedule. The Director will, in turn, forward the team's recommendations, along with the Director's own recommendations, to the Secretary of the Interior. The Secretary will make the final decision on whether to lease tracts and, if so, which tracts are to be offered.

The Secretary's decision is not limited solely to the alternatives presented in this EIS. The decision could include changes in the proposed level of leasing, different tract combinations, alteration of tract boundaries, or changes in the lease sale schedule. In making the decision, the Secretary will consider not only the environmental analysis included in this EIS but also expressed preferences of the Governors of Colorado and Wyoming; recommendations of the Regional Coal Team; public comments; coordination with other Federal agencies; and technical, regulatory, and policy considerations.

An additional area of concern is the possible effect of proposed exchanges affecting two tracts: the Point of Rocks Tract in southwestern Wyoming and Corral Canyon Tract in southcentral Wyoming. Detailed analysis of these proposed exchanges is beyond the scope of this EIS; they will be evaluated by the BLM Rock Springs District and Rawlins District, respectively. However, in general, impacts of coal development would be the same as those identified in this EIS, regardless of coal ownership.

CHAPTER 1

PURPOSE AND NEED FOR THE PROPOSED ACTION

As part of the Federal coal management program, the Department of the Interior, through the Bureau of Land Management (BLM), conducts competitive leasing of Federal coal to assure adequate coal supplies are available to meet national long-term energy requirements and adequate reserves are available to continue existing production. In accordance with this program, on January 6, 1983, the Secretary of the Interior established a leasing level range of 750 to 950 million tons of recoverable coal for the Green River-Hams Fork Coal Region. The leasing level includes both Federal and non-Federal coal. This is the second round of proposed Federal coal leasing in the region.

The leasing level was established after analyzing potential production from planned and existing coal mines in the region and projected demand for coal. The decision on the leasing level was made to ensure that sufficient coal resources are offered to enhance industry competition. It was based in part on the fact that industry formally expressed interest in some 1.3 to 1.5 billion tons of recoverable coal resources.

BACKGROUND INFORMATION

The Federal coal management program establishes coal production regions in the United States and provides for sales of coal leases in these regions to help meet the nation's projected energy demands.

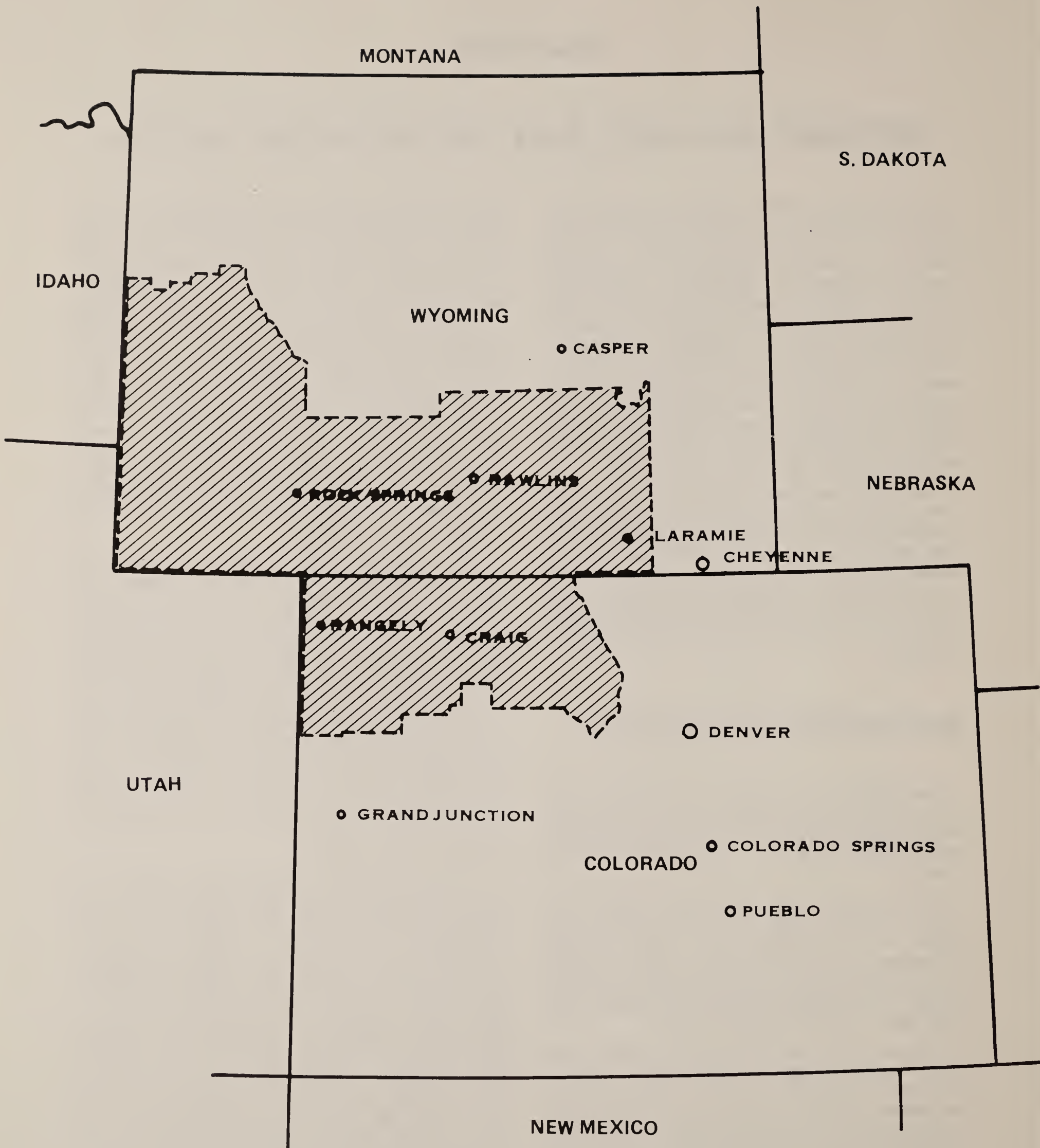
The area dealt with in this EIS is the Green River-Hams Fork Coal Region. This region comprises all or portions of Albany, Carbon, Sweetwater, Sublette, Lincoln, and Uinta counties in southwest Wyoming and Routt, Moffat, Jackson, Grand, and Rio Blanco counties in northwest Colorado. Map 1-1 portrays the coal region.

The first round final EIS for the Green River-Hams Fork Coal Region was released on February 29, 1980. On October 20, 1980, the Secretary of the Interior made a decision to sell 11 of the tracts considered in that EIS. Leases have been issued on all 11 tracts. A decision was also made by the Secretary to defer the decision on leasing a twelfth tract (Red Rim) pending results of a wildlife study. The study has been completed and the results were determined positive for leasing. However, the

leasing decision is still pending the outcome of an unsuitability petition filed with the Department of the Interior in July 1982. The petition was filed by the National Wildlife Federation and the Wyoming Wildlife Federation. It argues that the tract is unsuitable for surface mining because (1) it contains fragile lands that are valuable for pronghorn antelope habitat and (2) reclamation of the tract is not technically or economically feasible. An intervention petition was filed in March 1983 by the surface owner, Taylor Lawrence, arguing that the tract was reviewed for suitability during Round I land use planning and was determined suitable for surface mining. The Office of Surface Mining Reclamation and Enforcement is preparing an EIS as part of its evaluation of the petition; the EIS is scheduled for completion in April 1984.

BLM is now involved in the second round of Federal coal leasing in the Green River-Hams Fork region. Overall guidance for the leasing process is provided by the Regional Coal Team, which was organized on August 14, 1979, under the chairmanship of the BLM State Director from Utah. Other members are the BLM State Directors from Colorado and Wyoming and representatives of the Governors of Colorado and Wyoming. The Regional Coal Team has held public meetings to consider the various phases of the process which have led to the publication of this EIS. Records of these meetings are available from the Bureau of Land Management, Colorado State Office, 1037 - 20th Street, Denver, Colorado 80202.

The first step in the coal leasing process was land use planning. The potential coal lease tracts analyzed in this EIS have been delineated from the acceptable areas identified in the land use plans. Acceptable areas have been identified by applying four "screens" to Federal lands: high or moderate coal development potential, unsuitability criteria (43 CFR 3460), multiple land use decisions, and surface owner consultation. The plans are consistent with local and state land use plans. As a result of the unsuitability assessment, some areas have been dropped from further consideration for leasing. In addition, tract-specific mitigation measures have been developed to protect threatened or endangered wildlife species, alluvial valley floors, etc., within tracts (see Appendix 6). Two tracts in south-central Wyoming--Atlantic Rim and Northeast Cow Creek--have been determined suitable for further consideration for leasing pending completion of an



Map 1-1. Location Map

PURPOSE AND NEED

elk habitat use study (see the discussion of these two tracts in Appendix 2). Documentation of this land use planning process is on file at BLM's district offices in Craig, Colorado, and Rawlins and Rock Springs, Wyoming.

After the completion of land use planning, BLM issued a call for expressions of leasing interest in those areas found acceptable for further consideration. Information provided in response to this call included area of interest, desired tonnages, and proposed mining method (surface or subsurface). This information is on file with the BLM state offices in Denver, Colorado, and Cheyenne, Wyoming.

Expressions of interest and other geologic and mining information were used to delineate tracts for potential leasing. Individual tract delineation reports were prepared which provided pertinent coal resource and mining information. This information was used to develop a site specific environmental analysis for each tract. Included in these analyses were environmental, social, and economic factors pertinent to or affected by development of each tract. Also prepared were tract profile reports, which highlighted the tract delineation report and impacts determined to be significant or controversial in the site specific analyses. Documentation of these analyses is available for review at the Craig, Rawlins, and Rock Springs BLM district offices. Pertinent information on the individual tracts is summarized in Appendix 2.

At a public meeting on January 11, 1983, the Regional Coal Team (1) ranked the tracts as having high, moderate, or low desirability for coal development and (2) selected leasing alternatives.

The Regional Coal Team reviewed information from tract profile reports, maps, and other sources of information prior to ranking tracts and formulating alternatives. The team considered three major categories in tract ranking (coal economics, impacts on the natural environment, and socioeconomic impacts) and a set of subfactors to be considered under each category. See Appendix 1 for detailed information on the subfactors and the results of tract ranking.

The Regional Coal Team grouped the tracts into five alternatives: a no leasing alternative and four leasing alternatives: maximum, high, moderate, and low. These alternatives and the tracts they include are shown in Table 2-1 in Chapter 2. The Low Leasing alternative contains only the highly desirable tracts, with successively higher leasing alternatives adding the moderate and low ranked tracts in decreasing order of ranking. The High Leasing alternative is the preferred alternative.

The coal leasing program is fully described in the *Final Environmental Statement: Federal Coal Management Program*; the *Federal Coal Management Regulations* (43 CFR 3400); *The Federal Coal Management Program - A Narrative Description*; and the *Secretarial Issue Document-Federal Coal Management Program*. File copies of these documents are available for inspection at the Bureau of Land Management, Office of Public Affairs, 18th and C Streets NW, Washington, D.C., 20240.

PUBLIC SCOPING

Immediately after tract ranking and preliminary selection of leasing alternatives by the Regional Coal Team, a scoping period was provided to identify public concerns about the issues and alternatives to be addressed in this EIS and to allow the public to review and comment on the alternatives. As part of this process, public scoping meetings were held as follows:

January 24, 1983: Marriott Hotel, Denver, Colorado

January 25, 1983: BLM District Office, Rawlins, Wyoming

January 26, 1983: Holiday Inn, Rock Springs, Wyoming

January 27, 1983: Craig Moffat Library, Craig, Colorado

In addition, written comments were accepted through February 11, 1983.

The issues discussed in the next section of this chapter were presented in a preliminary form to stimulate discussion and comment. Comments subsequently received did not result in identification of any totally new issues within the scope of the EIS, but the preliminary issues were elaborated on, with concerns on specific areas or conflicts being expressed.

ISSUES

Issues identified through the Bureau's land use planning system and the scoping process and determined to be within the scope of this EIS are as follows:

General

The effectiveness of mitigation

PURPOSE AND NEED

Net energy balance of energy required for coal development and transportation versus the energy provided by coal itself

Minerals

Conflicts between coal production and oil and gas development

Air Quality

Impacts on visibility standards and other air quality parameters in towns, in Class I areas, and in the region

Water Resources

Impacts to water quality from contamination, aquifer destruction, and increased population; impacts to water quantity, including water availability for reclamation, other users, increased populations, and maintenance of minimum stream flows

Soils

Impacts to soils, including leaching and long-term stabilization

Vegetation

Loss of vegetation, including vegetation on agricultural lands and in riparian areas; effects on threatened or endangered plant species

Animal Life

The effects on critical and other wildlife habitat, both terrestrial and aquatic, including raptors and their associated buffer zones; effects of coal development on threatened or endangered species; impacts of urbanization (additional snowmobile and other ORV use, poaching, road kills, and blocked migration routes); and loss of wild horse range in Wyoming.

Land Use

Impacts on land use, including checkerboard patterns in Wyoming and changing land use patterns; potential effects of subsidence on current land uses; impacts on private as well as Federal lands; effects on livestock grazing; and potential for re-establishing vegetation capable of supporting the same uses as prior to disturbance

Economics and Social Values

Demands on local government and community facilities, such as housing, roads, schools, water and sewer systems, and health care; impacts on existing economic bases, such as agriculture, hunting, and tourism; and impacts on lifestyles

Recreation/Visual Resources

Impacts on potential and designated wilderness areas, ACECs, parks, trails, and monuments, as well as on recreational opportunities and facilities and the visual resources of the area

Transportation

Impacts on transportation systems

Noise

Noise impacts in relation to noise standards and existing sound levels in the affected area

Cultural Resources

Impacts to cultural resource values

Issues Not Addressed

Some of the issues identified prior to and during the scoping process are beyond the scope of the EIS, have been covered by prior environmental review, or are not considered to have a significant effect on the human environment within the area of study. These issues are listed below.

PURPOSE AND NEED

1. The advisability of leasing additional coal while the current coal market is 'soft'; selling public resources in a manner which maximizes, through competition, the monies returned to the Federal and local treasuries
2. The mineability of coal resources and availability of transportation in the Powder River basin, which make it more desirable for development than the Green River-Hams Fork Coal Region
3. The importance of leasing more coal to encourage development of improved transportation facilities in northwest Colorado
4. Exchanges of existing nonproducing leases that are less desirable from an environmental and economic standpoint for leases that are better suited for timely and efficient development
5. The adequacy of the land use plans in the Green River-Hams Fork Coal Region

AUTHORITIES FOR COAL LEASING AND DEVELOPMENT

The development of coal resources is controlled by numerous laws and regulations imposed by Federal, state, and local agencies and authorities. Federal laws of paramount importance include the Mineral Leasing Act of 1920, the Federal Coal Leasing Amendments Act of 1976, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977.

The Federal Coal Leasing Amendments Act provides a more complete procedure for the leasing and development of federally owned coal than was set forth in the Mineral Leasing Act of 1920. The Federal Coal Leasing Amendments Act sets forth several requirements, including competitive coal leasing, the abolishment of preference right leasing, maximum economic recovery, and consistency with land use planning.

The Federal Land Policy and Management Act provides BLM with a statutory framework for land use planning on public lands. This Act requires that BLM use the principles of multiple use, sustained yield, and environmental integrity; give priority to the protection of areas of critical environmental concern; consider present as well as future uses of public lands; and coordinate planning activities with those of Federal, state, and local government agencies.

The Surface Mining Control and Reclamation Act establishes uniform minimum Federal standards for regulating surface mining and reclamation on Federal, state, and private lands and for assuring ade-

quate protection from environmental impacts of surface mining. The Act also sets forth provisions regarding environmental protection performance standards and designation of areas unsuitable for surface coal mining operations. The act established the Office of Surface Mining Reclamation and Enforcement in the Department of the Interior to enforce the performance standards and provides for state regulation of coal mining, with oversight by the Office of Surface Mining.

This EIS involves two states: Colorado and Wyoming. Both have adopted state regulatory programs and have assumed primary jurisdiction over regulation of coal development within their respective boundaries, including Federal coal under a cooperative agreement with the Department of the Interior. The responsible state agencies in Colorado and Wyoming are the Colorado Mined Land Reclamation Board and the Wyoming Department of Environmental Quality.

Each lease operator is required to submit a permit application package that complies with state, Office of Surface Mining, and BLM regulations and which demonstrates that noncoal resources will be protected. Consultation is required between the regulatory authorities and the land management agencies prior to approval of a mining operation plan by the Secretary of the Interior.

On December 3, 1982, Department of the Interior Secretarial Order No. 3087 consolidated primary onshore mineral leasing functions of the Minerals Management Service with BLM. BLM therefore is authorized to supervise all aspects of leasing and production of coal resources in the lease areas. Included are the former Minerals Management Service responsibilities to enforce diligent development, attain maximum economic recovery, conserve mineral resources, and evaluate the economics of mining. The Minerals Management Service retains responsibility for royalty collection for onshore minerals.

Local level regulations are generally imposed at the county level. These involve special use permits, zoning variances, or construction permits, as applicable.

TIME FRAMES

Following the public comment period on this draft EIS, the Regional Coal Team may revise tract ranking and selection, based on the results of this EIS and public comment. The final EIS, which will reflect any such changes as well as responses to

PURPOSE AND NEED

public comments, is scheduled to be available to the public in February 1984.

After release of the final EIS, the Regional Coal Team will recommend to the Director of BLM (1) which specific tracts, if any, of the 24 analyzed should be offered for lease sale and (2) if appropriate, a lease sale schedule. The Director will, in turn, forward the team's recommendations, along with

the Director's own recommendations, to the Secretary of the Interior. The Secretary will make the final decision on whether to lease tracts and, if so, which tracts are to be offered. The Secretary will also determine the schedule of tract sales.

If coal leasing occurs, offering of coal leases for competitive sale will probably begin in June 1984.

CHAPTER 2

DESCRIPTION OF ALTERNATIVES INCLUDING THE PROPOSED ACTION

INTRODUCTION

This chapter provides a narrative description of the five alternatives analyzed in this document, a series of tables summarizing relevant data (production figures, acreage disturbances, etc.) for each, and a listing of mitigation measures. It concludes with a comparative analysis of the five alternatives' impacts.

The following five alternatives are analyzed in this environmental impact statement (EIS):

1. No Action
2. Low Leasing
3. Moderate Leasing
4. High Leasing (Agency Preferred Alternative)
5. Maximum Leasing

DESCRIPTION OF ALTERNATIVES

No Action Alternative (Baseline)

With one exception, the No Action alternative would not offer any of the 24 tracts for competitive leasing. No new annual production would be generated from these tracts, and there would be no disturbances from new Federal coal leasing and subsequent mining.

The exception would be Little Middle Creek, which has been included in the No Action alternative as well as in the proposed leasing alternatives. Under the No Action alternative, this tract could be leased as an emergency bypass. Bypass coal refers to an isolated coal deposit which cannot be economically mined as an individual operation in the foreseeable future. However, this bypass coal could be economically mined as an extension of an existing operation. This would be done under the emergency lease provisions contained in 43 CFR Part 3425.1-4. (See the discussion of Little Middle Creek in Appendix 2 or the Little Middle Creek Site Specific Analysis, which is available for review at the BLM Colorado State Office in Denver.)

However, even without new Federal leasing, activities would occur as a result of both coal and noncoal actions. Coal activities could include continued production from existing coal mines, development of existing nonproducing leases, and development of coal preference right lease applications. A number of preference right lease applications (PRLAs) are being processed separately under site-specific environmental assessments or environmental impact statements. These include the Savery PRLAs (a group of nine PRLAs on the Colorado--Wyoming border), the Consolidation Coal PRLA, the Jensen-Miller PRLA, and the Chapman-Riebald PRLA. These PRLAs are not included in the baseline for this EIS. Noncoal activities could include oil and gas production, oil shale development, trona development, increased recreation, urban expansion, and other factors.

To arrive at baseline, existing projects and production that could continue through the year 2000, along with projects and production that could logically materialize by the year 2000, were cumulated to estimate increased population and surface disturbance. This projection was made available for public comment during the public scoping process that occurred before the analysis in this EIS began.

Table 2-1 portrays the existing and possible future projects which were considered in developing the baseline. Inclusion in the baseline does not imply secretarial approval of any proposed projects involving Federal lands nor does it mean a particular project will, in fact, be developed. The baseline merely provides a starting point from which to assess impacts.

Figures 2-1 and 2-2 portray the baseline coal production figures by county and state.

It should be noted that if the baseline has been overestimated, the proposed leasing action will seem small in comparison to the baseline, while the cumulative effects of each alternative (baseline plus whatever amount of leasing is proposed by the alternative) will appear greater. Conversely, an underestimated baseline will cause projected impacts of proposed coal leasing to appear greater in comparison to the baseline but cumulative effects of each alternative to appear smaller.

DESCRIPTION OF ALTERNATIVES

Leasing Alternatives

These alternatives propose leasing levels ranging from 101.1 million tons to 990.7 million tons of recoverable coal. Leasing levels include both Federal and non-Federal coal. The non-Federal coal would not be leased by the Secretary's decision. However, it is assumed that once Federal coal was leased, the lessee would also lease the non-Federal coal, developing all of the coal resource in one mining operation.

A final decision to lease any of these tracts would not mean that they would, in fact, be sold or developed. However, any Federal lease would have a stipulation requiring diligent development.

Table 2-2 shows which tracts are included in each alternative, while figure 2-3 graphically portrays annual coal production for the various alternatives. Surface and mineral estate acreage are depicted in table 2-3. Tables 2-4 through 2-15 portray mineral resource values, acreage disturbance, and transportation and employment figures for each leasing alternative. For an overview of the tract boundaries and locations, see the folded color map in the map packet and map 2-1 in this chapter.

Low Leasing Alternative

The Low Leasing alternative represents a minimal leasing level of 101.1 million tons of recoverable coal. Seven tracts are proposed for lease sale: Deadman, Leucite Hills, Point of Rocks, and Tract 98 in Wyoming, and Prairie Dog, Little Middle Creek, and Middle Creek in Colorado.

Surface mining is proposed for five of the tracts; only Prairie Dog and Middle Creek are proposed subsurface mines. Deadman, Tract 98, and Little Middle Creek involve extensions of existing mines, while Leucite Hills, Point of Rocks, Prairie Dog, and Middle Creek are analyzed as new mines.

Tract size (surface acreage) varies from 160 to over 11,000 acres.

Moderate Leasing Alternative

The Moderate Leasing alternative represents an intermediate leasing level of 495.3 million tons of recoverable coal.

A total of 13 tracts would be offered for competitive leasing--the 7 tracts proposed for leasing under

the Low Leasing alternative plus 6 additional tracts. These 6 are the Atlantic Rim, Byrne Creek, Corral Canyon, and Wild Horse Draw tracts in Wyoming and the Rattlesnake Mesa and Signal Butte tracts in Colorado.

Surface mining is proposed for the four Wyoming tracts. Subsurface mining is proposed for Rattlesnake Mesa, while a combination of surface and subsurface mining is proposed for Signal Butte. All six tracts are analyzed as new mining operations.

High Leasing (Preferred) Alternative

The High Leasing alternative, which is also BLM's preferred alternative, represents a combination of tracts which falls within the Secretary's leasing level of 750 to 950 million tons. Under this alternative, 759.3 million tons of recoverable coal would be offered for lease sale.

A total of 19 tracts would be offered for competitive leasing--the 13 tracts proposed for leasing under the Moderate Leasing alternative plus 6 additional tracts. These 6 tracts are Pio, Winton, and Indian Springs in Wyoming, and Peck Gulch, Iles Mountain, and Fish Creek in Colorado.

Two tracts--Pio and Iles Mountain--are proposed surface mines. Subsurface mining is proposed for Winton and Peck Gulch, while a combination of surface and subsurface mining is proposed for Fish Creek. In situ gasification is proposed for Indian Springs. All six tracts are analyzed as new mining operations.

Maximum Leasing Alternative

The Maximum Leasing alternative proposes offering all 24 tracts for competitive leasing. This would result in a leasing level of 990.7 million tons of recoverable coal.

The 24 tracts to be offered for competitive leasing include the 19 tracts proposed for leasing under the High Leasing alternative plus 5 additional tracts. One of the 5, Northeast Cow Creek, is in Wyoming. The 4 Colorado tracts are Bell Rock, Williams Fork Mountain, Lay Creek, and Horse Gulch.

Surface mining is proposed for three tracts--Williams Fork Mountain, Lay Creek, and Horse Gulch. Subsurface mining is proposed on Northeast Cow Creek and Bell Rock tracts. All five tracts are analyzed as new mining operations.

TABLE 2-1

BASELINE PROJECTS AND ACREAGE DISTURBANCE TOTALS

COLORADO		WYOMING	
<u>Coal Projects</u>		<u>Coal Projects</u>	
ColoWyo (E)		Medicine Bow (E)	
Empire (E)		Seminoe 1 (E)	
Trapper (E)		Seminoe 2 (E)	
Sunland (E)		Carbon County (E)	
Edna (E)		Vanguard 2 (E)	
Colo Yampa (E)		Rosebud (E)	
Sun Coal (E)		Carbon Number 1 (E)	
Rock Castle (E)		China Butte (P)	
Yampa (E)		Red Rim (P)	
Deserado (E)		Carbon Basin (P)	
P & M (Fish Creek) (P)		Cherokee (P)	
Grassy Creek (P)		Black Butte (E)	
Hayden Gulch (P)		Bridger (E)	
Danforth II (P)		Leucite Hills (E)	
Little Bear (P)		Stansbury (E)	
Danforth III (P)		Long Canyon (P)	
Northern Coal (E & P)		Bean Springs (P)	
Utah International (P)		Table (P)	
Foidel Creek (P)		Black Butte Creek (P)	
Seneca (E) & Seneca 2W (P)		Kemmerer (E)	
		Skull Point (E)	
		North Block (P)	
		Twin Creek (P)	
		South Haystack (P)	
<u>Other Projects</u>		<u>Other Projects</u>	
Uranium		Trona	
Oil & Gas		Oil and Gas	
Ca Oil Shale		Pipeline & Processing	
Cb Oil Shale		Chevron Fertilizer Plant	
Prototype Oil Shale*		Secondary Development	
Aquatrain			
La Sal Pipeline			
Texas Eastern Pipeline			
Yellow Jacket Reservoir			
Secondary Development			
<u>Total Acreage Disturbed (Colorado and Wyoming)</u>			
1983	161,948		
1992	203,436		
1995	212,563		
2000	236,725		

NOTE: E = existing and P = proposed.

* Secretary's decision pending

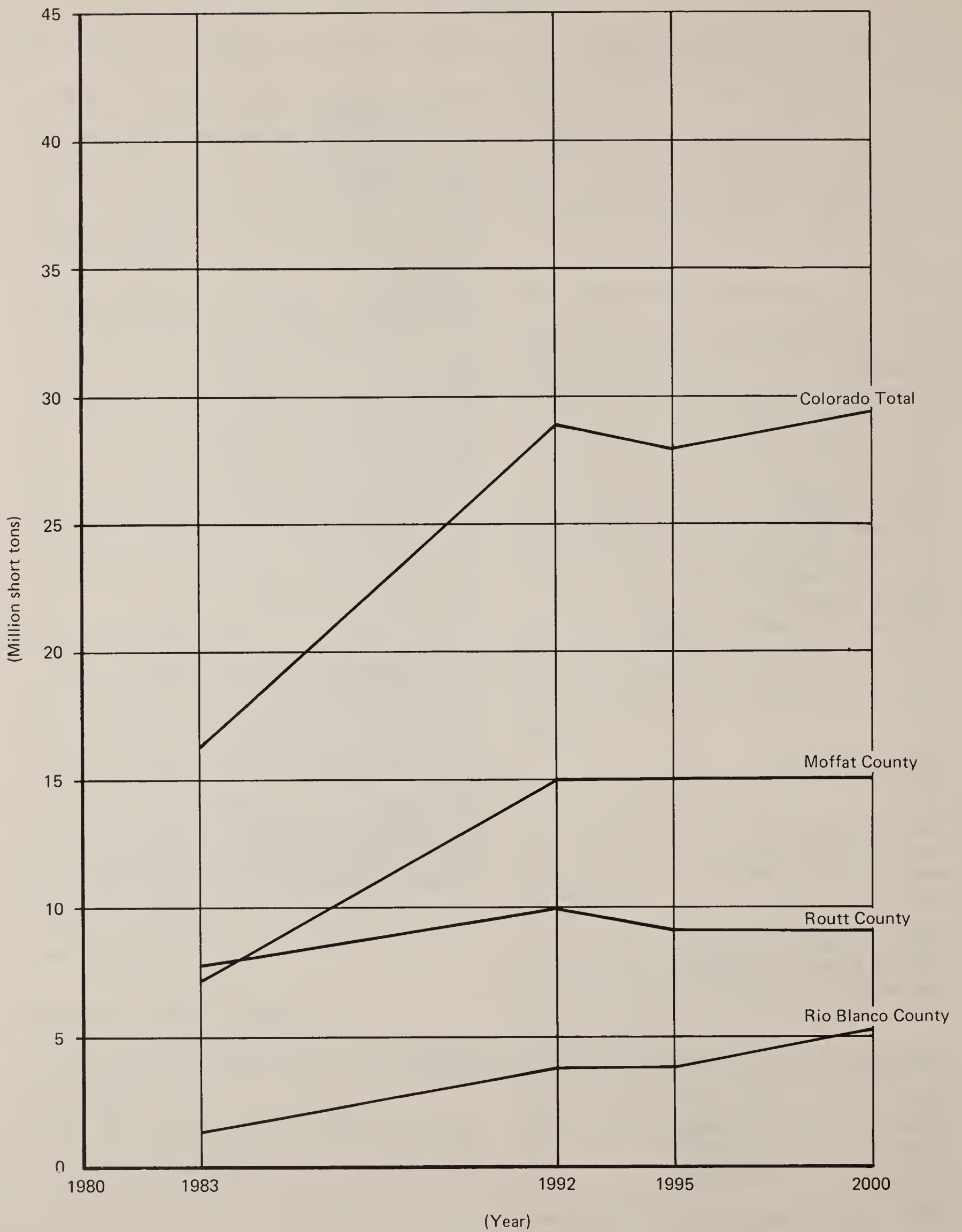


Figure 2-1. Projected Annual Baseline Coal Production for Colorado

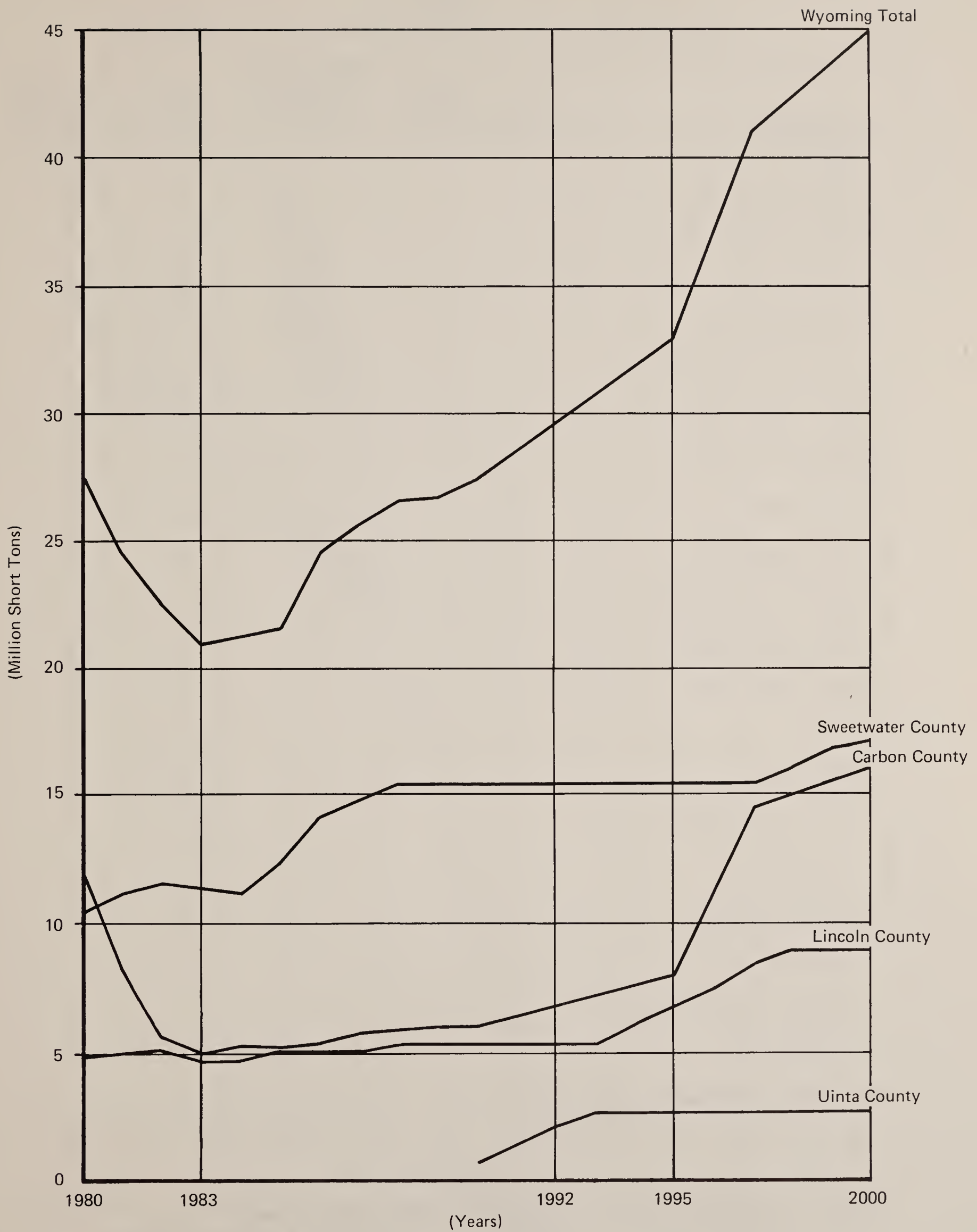


Figure 2-2. Projected Annual Baseline Coal Production for Wyoming

TABLE 2-2
TRACTS PROPOSED FOR LEASING UNDER THE FIVE ALTERNATIVES

Tracts*	Alternatives				
	No Action	Low Leasing	Moderate Leasing	High Leasing	Maximum Leasing
Deadman (W)		x	x	x	x
Leucite Hills (W)		x	x	x	x
Point of Rocks (W)		x	x	x	x
Tract 98 (W)		x	x	x	x
Prairie Dog (C)		x	x	x	x
Little Middle Creek (C)	x	x	x	x	x
Middle Creek (C)		x	x	x	x
Atlantic Rim (W)			x	x	x
Byrne Creek (W)			x	x	x
Corral Canyon (W)			x	x	x
Wild Horse Draw (W)			x	x	x
Rattlesnake Mesa (C)			x	x	x
Signal Butte (C)			x	x	x
Pio (W)				x	x
Winton (W)				x	x
Indian Springs (W)				x	x
Peck Gulch (C)				x	x
Iles Mountain (C)				x	x
Fish Creek (C)				x	x
Northeast Cow Creek (W)					x
Bell Rock (C)					x
Williams Fork Mountain (C)					x
Lay Creek (C)					x
Horse Gulch (C)					x

Note: x indicates tract is included in the alternative.

* (W) indicates tract is in Wyoming; (C) indicates a Colorado tract.

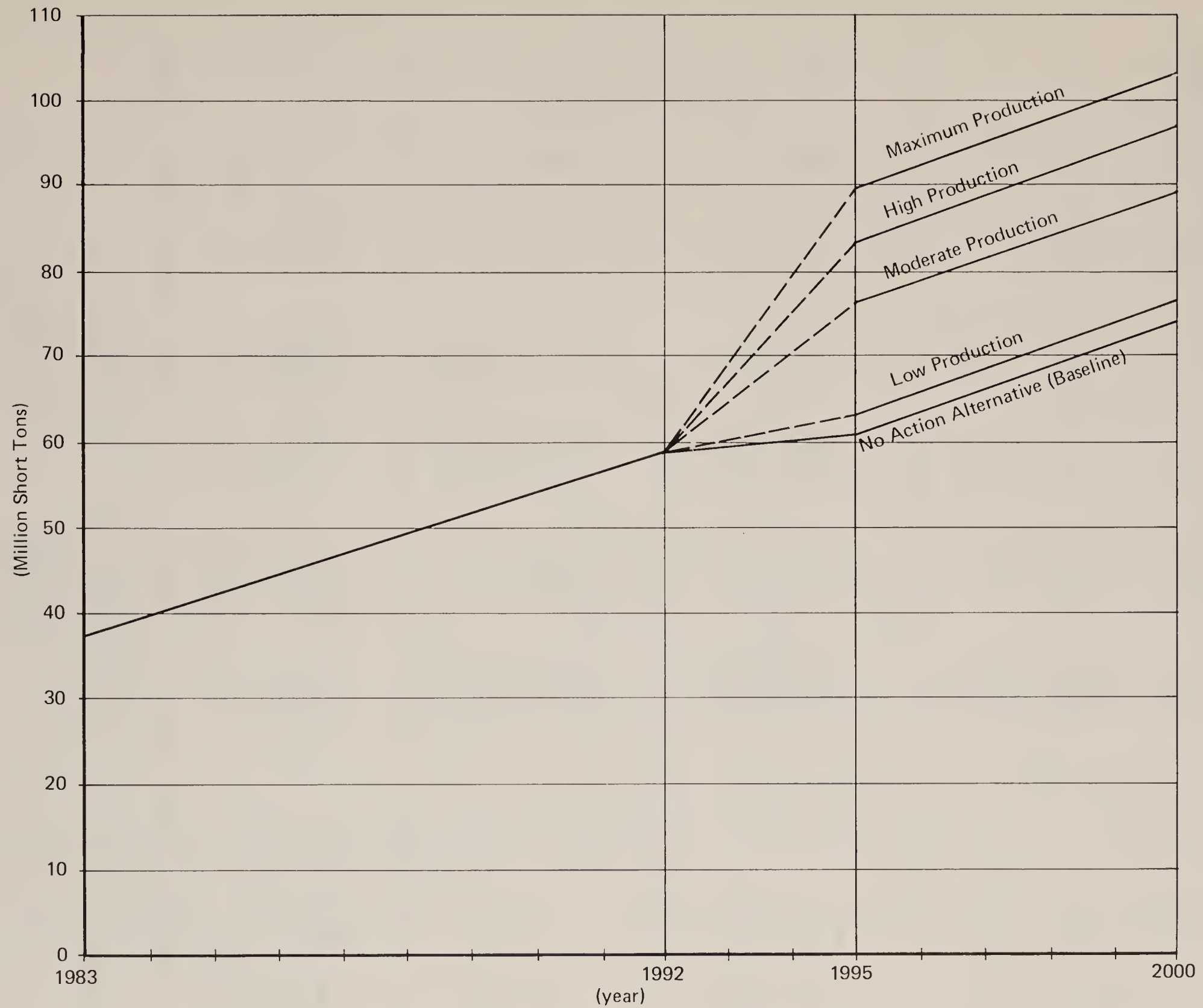


Figure 2-3. Projected Annual Cumulative Coal Production

TABLE 2-3
SURFACE AND MINERAL ESTATE ACREAGE

Tract	Total Acres	Federal		Private		State	
		Surface Estate	Mineral Estate	Surface Estate	Mineral Estate	Surface Estate	Mineral Estate
Deadman	160.0	160.0	160.0	0	0	0	0
Leucite Hills	4,682.5	2,441.3	2,441.3	2,241.2	2,241.2	0	0
Point of Rocks	4,016.3	1,998.0	1,998.0	1,538.3	1,538.3	480.0	480.0
Tract 98	164.8	164.8	164.8	0	0	0	0
Prairie Dog	11,517.9	11,516.3	11,517.9	1.6	0	0	0
Little Middle Creek	990.9	250.0	990.9	740.9	0	0	0
Middle Creek	1,080.0	40.0	1,080.0	1,040.0	0	0	0
Total Low Alternative	22,612.4	16,570.4	18,352.9	5,562.0	3,779.5	480.0	480.0
Atlantic Rim	9,372.4	4,210.0	3,649.9	5,162.4	5,002.4	0	720.0
Byrne Creek	2,230.0	430.0	870.0	1,720.0	1,280.0	80.0	80.0
Corral Canyon	3,440.0	1,000.0	1,000.0	2,440.0	2,440.0	0	0
Wild Horse Draw	2,560.0	1,280.0	1,280.0	1,280.0	1,280.0	0	0
Rattlesnake Mesa	936.2	352.7	936.2	583.5	0	0	0
Signal Butte	3,137.0	177.6	3,137.0	2,959.4	0	0	0
Total Moderate Alternative*	44,288.0	24,020.7	29,246.0	19,707.3	13,781.9	560.0	1,280.0
Pio	5,624.7	5,624.7	5,624.7	0	0	0	0
Winton	6,161.3	1,814.3	1,814.3	4,347.0	4,347.0	0	0
Indian Springs	2,435.4	1,396.2	1,396.2	1,039.2	1,039.2	0	0
Peck Gulch	1,923.0	171.8	1,923.0	1,751.2	0	0	0
Hies Mountain	2,847.4	960	2,847.4	1,887.4	0	0	0
Fish Creek	2,856.5	0	2,856.5	2,856.5	0	0	0
Total High Alternative*	66,136.3	33,987.7	45,688.1	31,588.6	19,168.1	560.0	1,280.0
Northeast Cow Creek	8,323.0	7,203.0	7,323.0	960.0	840.0	160.0	160.0
Beil Rock	1,935.1	221.4	1,935.1	1,393.7	0	320.0	0
Williams Fork Mountain	9,946.1	178.4	9,946.1	9,767.7	0	0	0
Lay Creek	9,961.9	1,494.7	8,761.5	7,827.2	560.4	640.0	640.0
Horse Gulch	4,117.0	1,680.0	4,117.0	2,437.0	0	0	0
Total Maximum Alternative*	100,419.4	44,765.2	77,770.8	53,974.2	20,568.5	1,680.0	2,080.0

* Each total is cumulative with the preceding totals.

TABLE 2-4

LOW LEASING ALTERNATIVE
MINERAL RESOURCE VALUES

Tract	Coal Reserves (million tons)						New Annual Production
	In-Place			Recoverable			
	Federal Resource	NonFederal Resource	Total Resource	Federal Resource	NonFederal Resource	Total Resource	
WYOMING							
Deadman *	3.4	0	3.4	0.3	0	0.3	(0.3)
Leucite Hills	54.8	42.3	97.1	6.5	11.2	17.7	0.5
Point of Rocks	34.0	13.9	47.9	13.6	3.9	17.5	0.5
Tract 98 *	3.8	0	3.8	3.4	0	3.4	(0.5)
Subtotal	96.0	56.2	152.2	23.8	15.1	38.9	1.0
COLORADO							
Prairie Dog	147.4	0	147.4	43.9	0	43.9	1.0
Little Middle Creek †	15.0	0	15.0	12.8	0	12.8	(3.3)
Middle Creek	26.6	0	26.6	5.5	0	5.5	0.1
Subtotal	189.0	0	189.0	62.2	0	62.2	1.1
Total	285.0	56.2	341.2	86.0	15.1	101.1	2.1

* Annual production would not represent an increase since this tract is an extension of an existing mining operation. Number in parentheses reflects continued rate of annual production.

† Tract coal reserves could also be leased under the No Action alternative (see narrative). Number in parentheses reflects continued rate of annual production.

TABLE 2-5

MODERATE LEASING ALTERNATIVE
MINERAL RESOURCE VALUES

Tract	Coal Reserves (million tons)						New Annual Production
	In-Place			Recoverable			
	Federal Resource	NonFederal Resource	Total Resource	Federal Resource	NonFederal Resource	Total Resource	
WYOMING							
Deadman *	3.4	0	3.4	0.3	0	0.3	(0.3)
Leucite Hills	54.8	42.3	97.1	6.5	11.2	17.7	0.5
Point of Rocks	34.0	13.9	47.9	13.6	3.9	17.5	0.5
Tract 98 *	3.8	0	3.8	3.4	0	3.4	(0.5)
Atlantic Rim	164.5	217.7	382.2	79.2	99.0	178.2	5.4
Byrne Creek	28.4	42.8	71.2	6.0	9.8	15.8	0.5
Corral Canyon	25.6	57.4	83.0	22.3	49.9	72.2	2.4
Wild Horse Draw	10.3	13.4	23.7	4.5	7.6	12.1	1.7
Subtotal	324.8	387.5	712.3	135.8	181.4	317.2	11.0
COLORADO							
Prairie Dog	147.4	0	147.4	43.9	0	43.9	1.0
Little Middle Creek †	15.0	0	15.0	12.8	0	12.8	(3.3)
Middle Creek	26.6	0	26.6	5.5	0	5.5	0.1
Rattlesnake Mesa	117.7	0	117.7	36.0	0	36.0	0.9
Signal Butte	257.8	0	257.8	79.9	0	79.9	2.0
Subtotal	564.5	0	564.5	178.1	0	178.1	4.0
Total	889.3	387.5	1,276.8	313.9	181.4	495.3	15.0

* Annual production would not represent an increase since this tract is an extension of an existing mining operation. Number in parentheses reflects continued rate of annual production.

† Tract coal reserves could also be leased under the No Action alternative (see narrative). Number in parentheses reflects continued rate of annual production.

TABLE 2-6

HIGH LEASING (PREFERRED) ALTERNATIVE
MINERAL RESOURCE VALUES

Tract	Coal Reserves (million tons)						New Annual Production
	In-Place			Recoverable			
	Federal Resource	NonFederal Resource	Total Resource	Federal Resource	NonFederal Resource	Total Resource	
WYOMING							
Deadman *	3.4	0	3.4	0.3	0	0.3	(0.3)
Leucite Hills	54.8	42.3	97.1	6.5	11.2	17.7	0.5
Point of Rocks	34.0	13.9	47.9	13.6	3.9	17.5	0.5
Tract 98 *	3.8	0	3.8	3.4	0	3.4	(0.5)
Atlantic Rim	164.5	217.7	382.2	79.2	99.0	178.2	5.4
Byrne Creek	28.4	42.8	71.2	6.0	9.8	15.8	0.5
Corral Canyon	25.6	57.4	83.0	22.3	49.9	72.2	2.4
Wild Horse Draw	10.3	13.4	23.7	4.5	7.6	12.1	1.7
Plo	133.4	0	133.4	11.1	0	11.1	0.5
Winton	39.2	99.5	138.7	19.6	49.8	69.4	2.0
Indian Springs	44.0	42.1	86.1	25.0	24.0	49.0	1.2
Subtotal	541.4	529.1	1,070.5	191.5	255.2	446.7	14.7
COLORADO							
Prairie Dog	147.4	0	147.4	43.9	0	43.9	1.0
Little Middle Creek †	15.0	0	15.0	12.8	0	12.8	(3.3)
Middle Creek	26.6	0	26.6	5.5	0	5.5	0.1
Rattlesnake Mesa	117.7	0	117.7	36.0	0	36.0	0.9
Signal Butte	257.8	0	257.8	79.9	0	79.9	2.0
Peck Gulch	112.8	0	112.8	36.7	0	36.7	1.2
Hes Mountain	38.2	0	38.2	33.5	0	33.5	1.7
Fish Creek	138.7	0	138.7	64.3	0	64.3	1.0
Subtotal	854.2	0	854.2	312.6	0	312.6	7.9
Total	1,395.6	529.1	1,924.7	504.1	255.2	759.3	22.6

* Annual production would not represent an increase since this tract is an extension of an existing mining operation. Number in parentheses reflects continued rate of annual production.

† Tract coal reserves could also be leased under the No Action alternative (see narrative). Number in parentheses reflects continued rate of annual production.

TABLE 2-7
MAXIMUM LEASING ALTERNATIVE
MINERAL RESOURCE VALUES

Tract	Coal Reserves (million tons)						New Annual Production
	In-Place			Recoverable			
	Federal Resource	NonFederal Resource	Total Resource	Federal Resource	NonFederal Resource	Total Resource	
<u>WYOMING</u>							
Deadman *	3.4	0	3.4	0.3	0	0.3	(0.3)
Leucite Hills	54.8	42.3	97.1	6.5	11.2	17.7	0.5
Point of Rocks	34.0	13.9	47.9	13.6	3.9	17.5	0.5
Tract 98 *	3.8	0	3.8	3.4	0	3.4	(0.5)
Atlantic Rim	164.5	217.7	382.2	79.2	99.0	178.2	5.4
Byrne Creek	28.4	42.8	71.2	6.0	9.8	15.8	0.5
Corral Canyon	25.6	57.4	83.0	22.3	49.9	72.2	2.4
Wild Horse Draw	10.3	13.4	23.7	4.5	7.6	12.1	1.7
Pio	133.4	0	133.4	11.1	0	11.1	0.5
Winton	39.2	99.5	138.7	19.6	49.8	69.4	2.0
Indian Springs	44.0	42.1	86.1	25.0	24.0	49.0	1.2
Northeast Cow Creek	192.2	19.9	212.1	82.8	8.8	91.6	1.8
Subtotal	733.6	549.0	1,282.6	274.3	264.0	538.3	16.5
<u>COLORADO</u>							
Prairie Dog	147.4	0	147.4	43.9	0	43.9	1.0
Little Middle Creek †	15.0	0	15.0	12.8	0	12.8	(3.3)
Middle Creek	26.6	0	26.6	5.5	0	5.5	0.1
Rattlesnake Mesa	117.7	0	117.7	36.0	0	36.0	0.9
Signal Butte	257.8	0	257.8	79.9	0	79.9	2.0
Peck Gulch	112.8	0	112.8	36.7	0	36.7	1.2
Iles Mountain	38.2	0	38.2	33.5	0	33.5	1.7
Fish Creek	138.7	0	138.7	64.3	0	64.3	1.0
Bell Rock	199.7	0	199.7	43.4	0	43.4	1.0
Williams Fork Mountain	45.9	0	45.9	39.0	0	39.0	1.3
Lay Creek	59.2	0	59.2	50.3	0	50.3	1.7
Horse Gulch	8.3	0	8.3	7.1	0	7.1	0.5
Subtotal	1,167.3	0	1,167.3	452.4	0	452.4	12.4
Total	1,900.9	549.0	2,449.9	726.7	264.0	990.7	28.9

* Annual production would not represent an increase since this tract is an extension of an existing mining operation. Number in parentheses reflects continued rate of annual production.

† Tract coal reserves could also be leased under the No Action alternative (see narrative). Number in parentheses reflects continued rate of annual production.

TABLE 2-8

LOW LEASING ALTERNATIVE
ACRES DISTURBED

Tract	On Tract										Off Tract									
	Extraction Disturbance					Facilities Disturbance					Direct Disturbance					Secondary Disturbance				
	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML
Wyoming																				
Deadman *	0	(75)	0	0	0		(5)	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucite Hills	0	44	146	316	1,200		122	323	658	2,400	0	67	67	67	67	0	13	36	36	36
Point of Rocks	0	48	162	352	1,150		64	226	496	1,630	0	20	20	20	20	0	18	18	18	18
Tract 98 *	0	(165)	(165)	(165)	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal	0	92	308	668	2,350		186	549	1,154	4,030	0	87	87	87	87	0	31	54	54	54
Colorado																				
Prairie Dog	0	0	0	0	0		40	40	40	40	0	110	110	110	110	0	26	55	55	55
Little Middle Creek †	0	(676)	0	0	0		(24)	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Creek	0	0	0	0	0		10	10	10	10	0	0	0	0	0	0	4	4	4	4
Subtotal	0	0	0	0	0		50	50	50	50	0	110	110	110	110	0	30	59	59	59
Total	0	92	308	668	2,350		236	599	1,204	4,080	0	197	197	197	197	0	61	113	113	113

NOTE: On-tract extraction disturbance includes only that area to be actually mined, while facilities disturbance includes all structures, haul roads, and topsoil and spoil stockpiles. Off-tract disturbance includes railroads, access roads, utility lines, structures, etc.

* This tract is being analyzed as an extension of an existing operation. It is assumed the tract would be mined in conjunction with the existing operation, which is already included in the baseline (no action alternative). Therefore, impacts from disturbance on this tract are not included in the subtotals and totals for the production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the numbers in parentheses indicate reclamation would be accomplished by the date shown.

† For analysis purposes, it is assumed this tract will qualify as an emergency bypass lease. Acreage disturbance has thus been included in the baseline and is not reflected in subtotals and totals for production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the number in parentheses indicate reclamation has been accomplished by the date shown.

TABLE 2-9

MODERATE LEASING ALTERNATIVE
ACRES DISTURBED

Tract	On Tract										Off Tract									
	Extraction Disturbance					Facilities Disturbance					Direct Disturbance					Secondary Disturbance				
	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML
Wyoming																				
Deadman *	0	(75)	0	0	0	0	(5)	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucite Hills	0	44	146	316	1,200	0	122	323	658	2,400	0	67	67	67	67	0	13	36	36	36
Point of Rocks	0	48	162	352	1,150	0	64	226	496	1,630	0	20	20	20	20	0	18	18	18	18
Tract 98 *	0	(165)	(165)	(165)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Rim	0	237	948	2,133	7,110	0	0	0	0	0	0	770	770	770	770	0	16	160	160	160
Byrne Creek	0	30	120	270	900	0	54	186	406	1,330	0	30	30	30	30	0	13	36	36	36
Corral Canyon	0	68	296	676	2,272	0	0	0	0	0	0	375	375	375	375	0	6	93	93	93
Wild Horse Draw	0	135	540	945	0	0	0	0	0	0	0	575	575	575	575	0	4	75	75	75
Subtotal	0	562	2,212	4,692	12,632	0	240	735	1,560	5,360	0	1,837	1,837	1,837	1,837	0	70	418	418	418
Colorado																				
Prairie Dog	0	0	0	0	0	0	40	40	40	40	0	110	110	110	110	0	26	55	55	55
Little Middle Creek †	0	(676)	0	0	0	0	(24)	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Creek	0	0	0	0	0	0	10	10	10	10	0	0	0	0	0	0	4	4	4	4
Rattlesnake Mesa	0	0	0	0	0	0	40	40	40	40	0	40	40	40	40	0	23	47	47	47
Signal Butte	0	87	348	783	0	0	123	189	299	123	0	318	318	318	318	0	7	29	29	68
Subtotal	0	87	348	783	0	0	213	279	389	213	0	468	468	468	468	0	60	135	135	174
Total	0	649	2,560	5,475	12,632	0	453	1,014	1,949	5,573	0	2,305	2,305	2,305	2,305	0	130	553	553	592

NOTE: On-tract extraction disturbance includes only that area to be actually mined, while facilities disturbance includes all structures, haul roads, and topsoil and spoil stockpiles. Off-tract disturbance includes railroads, access roads, utility lines, structures, etc.

* This tract is being analyzed as an extension of an existing operation. It is assumed the tract would be mined in conjunction with the existing operation, which is already included in the baseline (no action alternative). Therefore, impacts from disturbance on this tract are not included in the subtotals and totals for the production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the numbers in parentheses indicate reclamation would be accomplished by the date shown.

† For analysis purposes, it is assumed this tract will qualify as an emergency bypass lease. Acreage disturbance has thus been included in the baseline and is not reflected in subtotals and totals for production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the number in parentheses indicate reclamation has been accomplished by the date shown.

TABLE 2-10
HIGH LEASING (Preferred) ALTERNATIVE
ACRES DISTURBED

Tract	On Tract										Off Tract									
	Extraction Disturbance					Facilities Disturbance					Direct Disturbance									
	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML
Wyoming																				
Deadman *	0	(75)	0	0	0	0	(5)	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucite Hills	0	44	146	316	1,200	0	122	323	658	2,400	0	67	67	67	67	0	13	36	36	36
Point of Rocks	0	48	162	352	1,150	0	64	226	496	1,630	0	20	20	20	20	0	18	18	18	18
Tract 98 *	0	(165)	(165)	(165)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Rim	0	237	948	2,133	7,110	0	0	0	0	0	0	770	770	770	770	0	16	160	160	160
Byrne Creek	0	30	120	270	900	0	54	186	406	1,330	0	30	30	30	30	0	13	36	36	36
Corral Canyon	0	68	296	676	2,272	0	0	0	0	0	0	375	375	375	375	0	6	93	93	93
Wild Horse Draw	0	135	540	945	0	0	0	0	0	0	0	575	575	575	575	0	4	75	75	75
Pio	0	47	176	391	950	0	117	336	701	1,650	0	284	284	284	284	0	14	36	36	36
Winton	0	0	0	0	0	0	43	43	43	43	0	62	62	62	62	0	32	104	239	239
Indian Springs	0	0	0	0	0	0	100	100	100	100	0	100	100	100	100	0	63	69	69	69
Subtotal	0	609	2,388	5,083	13,582	0	500	1,214	2,404	7,153	0	2,283	2,283	2,283	2,283	0	179	627	762	762
Colorado																				
Prairie Dog	0	0	0	0	0	0	40	40	40	40	0	110	110	110	110	0	26	55	55	55
Little Middle Creek †	0	(676)	0	0	0	0	(24)	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Creek	0	0	0	0	0	0	10	10	10	10	0	0	0	0	0	0	4	4	4	4
Rattlesnake Mesa	0	0	0	0	0	0	40	40	40	40	0	40	40	40	40	0	23	47	47	47
Signal Butte	0	87	348	783	0	0	123	189	299	123	0	318	318	318	318	0	7	29	29	68
Peck Gulch	0	0	0	0	0	0	40	40	40	40	0	80	80	80	80	0	43	81	81	81
Hies Mountain	0	47	158	343	750	0	103	142	207	350	0	80	80	80	80	0	22	40	40	40
Fish Creek	0	100	200	0	0	0	100	100	100	100	0	25	25	25	25	0	9	16	65	65
Subtotal	0	234	706	1,126	750	0	456	561	736	703	0	653	653	653	653	0	134	272	321	360
Total	0	843	3,094	6,209	14,332	0	956	1,775	3,140	7,856	0	2,936	2,936	2,936	2,936	0	313	899	1,083	1,122

NOTE: On-tract extraction disturbance includes only that area to be actually mined, while facilities disturbance includes all structures, haul roads, and topsoil and spoil stockpiles. Off-tract disturbance includes railroads, access roads, utility lines, structures, etc.

* This tract is being analyzed as an extension of an existing operation. It is assumed the tract would be mined in conjunction with the existing operation, which is already included in the baseline (no action alternative). Therefore, impacts from disturbance on this tract are not included in the subtotals and totals for the production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the numbers in parentheses indicate reclamation would be accomplished by the date shown.

† For analysis purposes, it is assumed this tract will qualify as an emergency bypass lease. Acreage disturbance has thus been included in the baseline and is not reflected in subtotals and totals for production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the number in parentheses indicate reclamation has been accomplished by the date shown.

TABLE 2-11
MAXIMUM LEASING ALTERNATIVE
ACRES DISTURBED

Tract	On Tract										Off Tract									
	Extraction Disturbance					Facilities Disturbance					Direct Disturbance									
	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML	1983	1992	1995	2000	EML
Wyoming																				
Deadman *	0	(75)	0	0	0	0	(5)	0	0	0	0	0	0	0	0	0	0	0	0	0
Leucite Hills	0	44	146	316	1,200	0	122	323	658	2,400	0	67	67	67	67	0	13	36	36	36
Point of Rocks	0	48	162	352	1,150	0	64	226	496	1,630	0	20	20	20	20	0	18	18	18	18
Tract 98 *	0	(165)	(165)	(165)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic Rim	0	237	948	2,133	7,110	0	0	0	0	0	0	770	770	770	770	0	16	160	160	160
Byrne Creek	0	30	120	270	900	0	54	186	406	1,330	0	30	30	30	30	0	13	36	36	36
Corral Canyon	0	68	296	676	2,272	0	0	0	0	0	0	375	375	375	375	0	6	93	93	93
Wild Horse Draw	0	135	540	945	0	0	0	0	0	0	0	575	575	575	575	0	4	75	75	75
Pio	0	47	176	391	950	0	117	336	701	1,650	0	284	284	284	284	0	14	36	36	36
Winton	0	0	0	0	0	0	43	43	43	43	0	62	62	62	62	0	32	104	239	239
Indian Springs	0	0	0	0	0	0	100	100	100	100	0	100	100	100	100	0	63	69	69	69
Northeast Cow Creek	0	0	0	0	0	0	40	40	40	40	0	420	420	420	420	0	40	227	226	226
Subtotal	0	609	2,388	5,083	13,582	0	540	1,254	2,444	7,193	0	2,703	2,703	2,703	2,703	0	219	854	988	988
Colorado																				
Prairie Dog	0	0	0	0	0	0	40	40	40	40	0	110	110	110	110	0	26	55	55	55
Little Middle Creek †	0	(676)	0	0	0	0	(24)	0	0	0	0	0	0	0	0	0	0	0	0	0
Middle Creek	0	0	0	0	0	0	10	10	10	10	0	0	0	0	0	0	4	4	4	4
Rattlesnake Mesa	0	0	0	0	0	0	40	40	40	40	0	40	40	40	40	0	23	47	47	47
Signal Butte	0	87	348	783	0	0	123	189	299	123	0	318	318	318	318	0	7	29	29	68
Peck Gulch	0	0	0	0	0	0	40	40	40	40	0	80	80	80	80	0	43	81	81	81
Iles Mountain	0	47	158	343	750	0	103	142	207	350	0	80	80	80	80	0	22	40	40	40
Fish Creek	0	100	200	0	0	0	100	100	100	100	0	25	25	25	25	0	9	16	65	65
Bell Rock	0	0	0	0	0	0	50	50	50	50	0	45	45	45	45	0	34	66	66	66
Williams Fork Mountain	0	103	457	1,047	3,525	0	73	106	161	392	0	65	65	65	65	0	18	30	30	30
Lay Creek	0	55	220	495	1,650	0	126	156	206	416	0	385	385	385	385	0	25	45	45	45
Horse Gulch	0	55	238	543	909	0	66	102	162	234	0	100	100	100	100	0	12	13	13	13
Subtotal	0	447	1,621	3,211	6,834	0	771	975	1,315	1,795	0	1,248	1,248	1,248	1,248	0	223	426	475	514
Total	0	1,056	4,009	8,294	20,416	0	1,311	2,229	3,759	8,988	0	3,951	3,951	3,951	3,951	0	442	1,280	1,463	1,502

NOTE: On-tract extraction disturbance includes only that area to be actually mined, while facilities disturbance includes all structures, haul roads, and topsoil and spoil stockpiles. Off-tract disturbance includes railroads, access roads, utility lines, structures, etc.

* This tract is being analyzed as an extension of an existing operation. It is assumed the tract would be mined in conjunction with the existing operation, which is already included in the baseline (no action alternative). Therefore, impacts from disturbance on this tract are not included in the subtotals and totals for the production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the numbers in parentheses indicate reclamation would be accomplished by the date shown.

† For analysis purposes, it is assumed this tract will qualify as an emergency bypass lease. Acreage disturbance has thus been included in the baseline and is not reflected in subtotals and totals for production alternatives. However, impacts from the acreage disturbance on this tract were still analyzed (acreage figure in parentheses). Zeroes after the number in parentheses indicate reclamation has been accomplished by the date shown.

TABLE 2-12

LOW LEASING ALTERNATIVE
TRANSPORTATION AND EMPLOYMENT

Tract	Off-Tract Coal Transportation (miles)				Employment	
	New	Road Upgrade	Rail	Conveyor	Construction	Mining Production
<u>Wyoming</u>						
Deadman *	0	0	0	0	0	0
Leucite Hills	5.5	0	0	0	40	80
Point of Rocks	2.0	0	0	0	0	40
Tract 98*	0	0	0	0	0	0
Subtotal	7.5	0	0	0	40	120
<u>Colorado</u>						
Prairie Dog	0	0	0	3.5	100	250
Little Middle Creek *	0	0	0	0	0	0
Middle Creek	0	0	0	0	10	10
Subtotal	0	0	0	3.5	110	260
Total	7.5	0	0	3.5	150	380

NOTE: In some instances, no new transportation facilities would be needed; existing truck and rail lines would receive increased use.

* Since this tract represents an extension of an existing mining operation, existing facilities and employees would be utilized; it is assumed that no new transportation facilities or hiring of employees would be required.

TABLE 2-13
MODERATE LEASING ALTERNATIVE
TRANSPORTATION AND EMPLOYMENT

Tract	Off-Tract Coal Transportation (miles)				Employment	
	New	Road Upgrade	Rail	Conveyor	Construction	Mining Production
<u>Wyoming</u>						
Deadman *	0	0	0	0	0	0
Leucite Hills	5.5	0	0	0	40	80
Point of Rocks	2.0	0	0	0	0	40
Tract 98 *	0	0	0	0	0	0
Atlantic Rim	0	21.0	19.0	0	48	346
Byrne Creek	4.0	0	0	0	40	80
Corral Canyon	6.0	10.0	3.0	0	20	202
Wild Horse Draw	6.0	13.0	14.0	0	14	164
Subtotal	23.5	44.0	36.0	0	162	912
<u>Colorado</u>						
Prairie Dog	0	0	0	3.5	100	250
Little Middle Creek	0	0	0	0	0	0
Middle Creek *	0	0	0	0	10	10
Rattlesnake Mesa	0	0	0	0	80	210
Signal Butte †	0	0	18.0	0	120	300
Subtotal	0	0	18.0	3.5	310	770
Total	23.5	44.0	54.0	3.5	472	1,682

NOTE: In some instances, no new transportation facilities would be needed; existing truck and rail lines would receive increased use.

* Since this tract represents an extension of an existing mining operation, existing facilities and employees would be utilized; it is assumed that no new transportation facilities or hiring of employees would be required.

† For the first nine years of mine life, construction/mining production employment would be 75/170.

TABLE 2-14
HIGH LEASING (PREFERRED) ALTERNATIVE
TRANSPORTATION AND EMPLOYMENT

Tract	Off-Tract Coal Transportation (miles)				Employment	
	Road New	Upgrade	Rail	Conveyor	Construction	Mining Production
<u>Wyoming</u>						
Deadman *	0	0	0	0	0	0
Leucite Hills	5.5	0	0	0	40	80
Point of Rocks	2.0	0	0	0	0	40
Tract 98 *	0	0	0	0	0	0
Atlantic Rim	0	21.0	19.0	0	48	346
Byrne Creek	4.0	0	0	0	40	80
Corral Canyon	6.0	10.0	3.0	0	20	202
Wild Horse Draw	6.0	13.0	14.0	0	14	164
Pio	1.0	0	7.0	0	60	80
Winton	0	0	4.2	0	100	524
Indian Springs	0	0	0	0 **	200	150
Subtotal	24.5	44.0	47.2	0	522	1,666
<u>Colorado</u>						
Prairie Dog	0	0	0	3.5	100	250
Little Middle Creek *	0	0	0	0	0	0
Middle Creek	0	0	0	0	10	10
Rattlesnake Mesa	0	0	0	0	80	210
Signal Butte †	0	0	18.0	0	120	300
Peck Gulch	2.0	13.0	0	0	120	300
Iles Mountain	0	0	0.3	0	60	140
Fish Creek °	0	0	0	0	40	250
Subtotal	2.0	13.0	18.3	3.5	530	1,460
Total	26.5	57.0	65.5	3.5	1,052	3,126

NOTE: In some instances, no new transportation facilities would be needed; existing truck and rail lines would receive increased use.

* Since this tract represents an extension of an existing mining operation, existing facilities and employees would be utilized; it is assumed that no new transportation facilities or hiring of employees would be required.

† For the first nine years of mine life, construction/mining production employment would be 75/170.

° For the first three years of mine life, construction/mining production employment would be 45/80.

** 15 miles of pipeline are proposed for this coal gasification project.

TABLE 2-15
MAXIMUM LEASING ALTERNATIVE
TRANSPORTATION AND EMPLOYMENT

Tract	Off-Tract Coal Transportation (miles)				Employment	
	Road		Rail	Conveyor	Construction	Mining Production
	New	Upgrade				
Wyoming						
Deadman *	0	0	0	0	0	0
Leucite Hills	5.5	0	0	0	40	80
Point of Rocks	2.0	0	0	0	0	40
Tract 98 *	0	0	0	0	0	0
Atlantic Rim	0	21.0	19.0	0	48	346
Byrne Creek	4.0	0	0	0	40	80
Corral Canyon	6.0	10.0	3.0	0	20	202
Wild Horse Draw	6.0	13.0	14.0	0	14	164
Pio	1.0	0	7.0	0	60	80
Winton	0	0	4.2	0	100	524
Indian Springs	0	0	0	0**	200	150
Northeast Cow Creek	1.5	26.0	16.0	0	125	492
Subtotal	26.0	70.0	63.2	0	647	2,158
Colorado						
Prairie Dog	0	0	0	3.5	100	250
Little Middle Creek *	0	0	0	0	0	0
Middle Creek	0	0	0	0	10	10
Rattlesnake Mesa	0	0	0	0	80	210
Signal Butte †	0	0	18.0	0	120	300
Peck Gulch	2.0	13.0	0	0	120	300
Iles Mountain	0	0	0.3	0	60	140
Fish Creek °	0	0	0	0	40	250
Bell Rock	0	6.0	0	0	100	250
Williams Fork Mountain	0	11.0	0	0	60	100
Lay Creek	0	0	7.0	0	75	170
Horse Gulch	1.0	0	0	0	40	50
Subtotal	3.0	30.0	25.3	3.5	805	2,030
Total	29.0	100.0	88.5	3.5	1,452	4,188

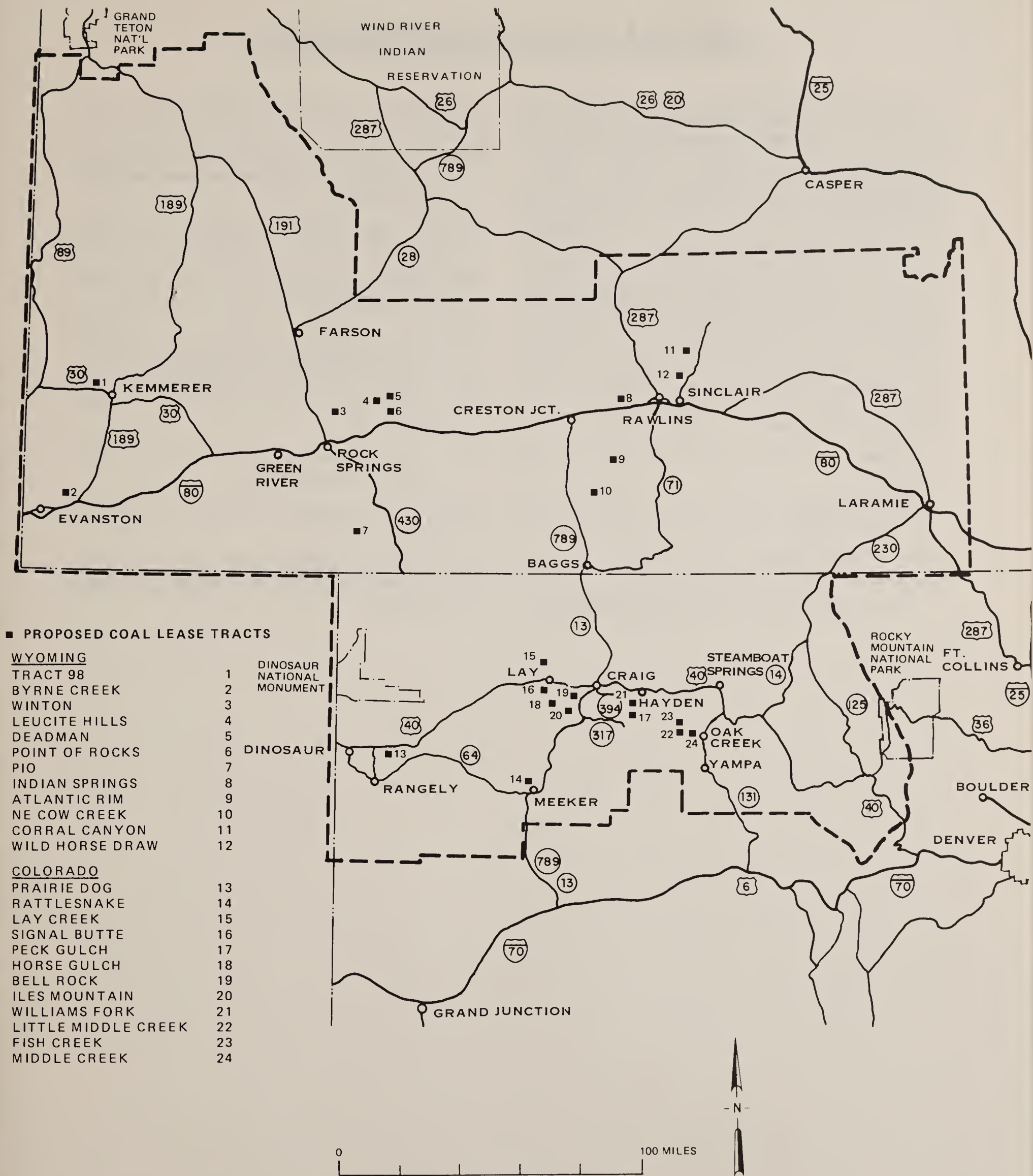
NOTE: In some instances, no new transportation facilities would be needed; existing truck and rail lines would receive increased use.

* Since this tract represents an extension of an existing mining operation, existing facilities and employees would be utilized; it is assumed that no new transportation facilities or hiring of employees would be required.

† For the first nine years of mine life, construction/mining production employment would be 75/170.

° For the first three years of mine life, construction/mining production employment would be 45/80.

** 15 miles of pipeline are proposed for this coal gasification project.



Map 2-1. Green River - Hams Fork EIS Coal Region

MITIGATION REQUIREMENTS

Lessees will be required to develop their Federal leases in compliance with all applicable Federal, state, and local laws and regulations. These are considered to be in-place constraints to a lessee's activities. Therefore, enforceable statutes, performance standards, and other license requirements are considered part of proposed Federal actions under all alternatives and are applicable to all coal tracts.

Additional mitigation measures have been developed through BLM's land use planning and activity planning processes. As such, these measures are considered to be real, committed, and legally enforceable. Since they were developed prior to starting the environmental analysis in this EIS, mitigation requirements have been factored into the analysis, i.e., only impacts remaining after mitigation is applied are considered.

Mitigation measures that have been developed include:

Cultural resources: Field inventory and data recovery procedures

Existing rights: Negotiation procedures

Black-footed ferret habitat: Monitoring and inventory in accordance with prescribed guidelines

Paleontological resources: Survey and data recovery

Water resources: Identification of affected water resources, including anticipated impacts and proposed mitigation

Raptors: Buffer zones, restrictions on surface mining

Wildlife habitat: Recovery using forage manipulation and other techniques

Subsidence and faulting: Prevention or minimization, including specific procedures to be used

Public access: Continued access unless interference with mining operations or safety hazards would result

Flood plains and alluvial valley floors: No surface occupancy or disturbance

Powersite withdrawals: Prior right to use land for power development

More detailed information on mitigation requirements, including site-specific measures, is presented in Appendix 6.

COMPARISON OF ALTERNATIVES

This section consists of a series of tables comparing significant impacts, unknown but potentially significant impacts, and other factors for the various alternatives. Impacts are grouped by resource.

A black triangle is used to indicate an impact which is not significant under a given alternative but which becomes significant under a higher level alternative. Significant impacts are indicated by a black square. Additional black squares indicate that the magnitude of an already significant impact has increased.

The No Action columns identify impacts that are significant even without additional leasing, i.e., ba-

seline impacts. These impacts generally increase in magnitude under the four leasing alternatives.

Tables 2-16, 2-17, and 2-18 compare impacts by alternative for each of three subregions: Northwest Colorado, South-Central Wyoming, and Southwest Wyoming.

Table 2-19 provides a summary comparison by alternative for the overall coal region.

Finally, tables 2-20, 2-21, and 2-22 show how individual tracts contribute to cumulative impact levels.

Table 2-16. Comparison of Impacts for Northwest Colorado Subregion

SIGNIFICANT IMPACTS	No Action	Low Production	Moderate Production	High Production	Maximum Production
AIR QUALITY: Total suspended particulates (24 hr.)					
Sulfur dioxide concentrations (annual)					
GEOLOGY: Alterations to topography					
Conservation of coal resource					
WATER: Increased salinity in Fish & Trout creeks					
Increased salinity of Green River					
Increased salinity of Colorado River (Regional)					
Degradation of groundwater quality					
Increase in sediment yield of Albert Creek					
Reduction of flow in Separation Creek					
VEGETATION: Loss of scarce vegetation type					
WILDLIFE: Loss of sagebrush habitat					
Loss of big game winter habitat					
Loss of deer					
Loss of aquatic habitat of Fish & Trout creeks					
Loss of fisheries in Fish & Trout creeks					
Loss of raptor nests					
Loss of antelope					
Loss of elk					
Loss of riparian habitat					
Loss of sage grouse					
RECREATION: Urban recreation shortfall					
Degradation of visual resource management Class II					
LAND USE: Loss of grazing use					
ECONOMICS: Increased employment/income					
Increased revenues					
Community growth exceeding ability to pay for it					
Insufficient housing					
SOCIAL: Disruptive social change					
TRANSPORTATION: Increased community traffic					
Loss of life & property/increased accidents (Regional)					
Increased average daily county road traffic					
Increased average daily traffic Highway 40 & 13					
NOISE: Increased noise on Highway 40 & 13					
Increased noise on county roads used to haul coal					
UNKNOWN IMPACTS *					
GEOLOGY: Loss of fossils					
Subsidence potential					
WATER: Increased salinity of surface water					
Modification of groundwater flow					
Impact to Fish Creek alluvial valley floor					
Aquifer pollution from toxic by-products					
WILDLIFE: Loss of aspen habitat **					
Loss of big game winter habitat **					
Loss of elk **					
LAND USE: Impact of withdrawal on mining					
NOISE: Increased noise frequency from rail traffic					
OTHER FACTORS †					
Landslide potential					
Hazard: Methane					
No coal access on tract					
Mineability of tract					
Conflict between rights-of-way/mining					

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-17. Comparison of Impacts for South-Central Wyoming Subregion

SIGNIFICANT IMPACTS	No Action	Low Production	Moderate Production	High Production	Maximum Production
AIR QUALITY: Total suspended particulates (24 hr.)					
Sulfur dioxide concentrations (annual)				■	■
GEOLOGY: Alterations to topography					
Conservation of coal resource					■
WATER: Increased salinity in Fish & Trout creeks					
Increased salinity of Green River					
Increased salinity of Colorado River (Regional)	■	■	■	■	■
Degradation of groundwater quality			■	■	■
Increase in sediment yield of Albert Creek			■	■	■
Reduction of flow in Separation Creek			■	■	■
VEGETATION: Loss of scarce vegetation type				■	■
WILDLIFE: Loss of sagebrush habitat			■	■	■
Loss of big game winter habitat					
Loss of deer					
Loss of aquatic habitat of Fish & Trout creeks					
Loss of fisheries in Fish & Trout creeks					
Loss of raptor nests			■	■	■
Loss of antelope					
Loss of elk					
Loss of riparian habitat	■	■	■	■	■
Loss of sage grouse			■	■	■
RECREATION: Urban recreation shortfall				■	■
Degradation of visual resource management Class II			■	■	■
LAND USE: Loss of grazing use					
ECONOMICS: Increased employment/income				■	■
Increased revenues				■	■
Community growth exceeding ability to pay for it			■	■	■
Insufficient housing			■	■	■
SOCIAL: Disruptive social change			■	■	■
TRANSPORTATION: Increased community traffic					
Loss of life & property/increased accidents (Regional)			■	■	■
Increased average daily county road traffic			■	■	■
Increased average daily traffic Highway 40 & 13					
NOISE: Increased noise on Highway 40 & 13					
Increased noise on county roads used to haul coal					
UNKNOWN IMPACTS *					
GEOLOGY: Loss of fossils			■	■	■
Subsidence potential					
WATER: Increased salinity of surface water			■	■	■
Modification of groundwater flow					
Impact to Fish Creek alluvial valley floor					
Aquifer pollution from toxic by-products					
WILDLIFE: Loss of aspen habitat **			■	■	■
Loss of big game winter habitat **					
Loss of elk **					
LAND USE: Impact of withdrawal on mining					
NOISE: Increased noise frequency from rail traffic			■	■	■
OTHER FACTORS †					
Landslide potential			■	■	■
Hazard: Methane					
No coal access on tract					
Mineability of tract					
Conflict between rights-of-way/mining					

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-18. Comparison of Impacts for Southwest Wyoming Subregion

SIGNIFICANT IMPACTS	No Action	Low Production	Moderate Production	High Production	Maximum Production
AIR QUALITY: Total suspended particulates (24 hr.)					
Sulfur dioxide concentrations (annual)					
GEOLOGY: Alterations to topography		■	■	■	■
Conservation of coal resource					
WATER: Increased salinity in Fish & Trout creeks					
Increased salinity of Green River	■	■	■	■	■
Increased salinity of Colorado River (Regional)		■	■	■	■
Degradation of groundwater quality		■	■	■	■
Increase in sediment yield of Albert Creek					
Reduction of flow in Separation Creek					
VEGETATION: Loss of scarce vegetation type					
WILDLIFE: Loss of sagebrush habitat	■	■	■	■	■
Loss of big game winter habitat					
Loss of deer	■	■	■	■	■
Loss of aquatic habitat of Fish & Trout creeks					
Loss of fisheries in Fish & Trout creeks					
Loss of raptor nests		■	■	■	■
Loss of antelope		■	■	■	■
Loss of elk		■	■	■	■
Loss of riparian habitat	■	■	■	■	■
Loss of sage grouse					
RECREATION: Urban recreation shortfall		■	■	■	■
Degradation of visual resource management Class II					
LAND USE: Loss of grazing use					
ECONOMICS: Increased employment/income					
Increased revenues		■	■	■	■
Community growth exceeding ability to pay for it					
Insufficient housing					
SOCIAL: Disruptive social change					
TRANSPORTATION: Increased community traffic		■	■	■	■
Loss of life & property/increased accidents (Regional)		■	■	■	■
Increased average daily county road traffic		■	■	■	■
Increased average daily traffic Highway 40 & 13					
NOISE: Increased noise on Highway 40 & 13					
Increased noise on county roads used to haul coal					
UNKNOWN IMPACTS *					
GEOLOGY: Loss of fossils		■	■	■	■
Subsidence potential					
WATER: Increased salinity of surface water		■	■	■	■
Modification of groundwater flow					
Impact to Fish Creek alluvial valley floor					
Aquifer pollution from toxic by-products					
WILDLIFE: Loss of aspen habitat **					
Loss of big game winter habitat **					
Loss of elk **					
LAND USE: Impact of withdrawal on mining					
NOISE: Increased noise frequency from rail traffic		■	■	■	■
OTHER FACTORS †					
Landslide potential					
Hazard: Methane					
No coal access on tract					
Mineability of tract					
Conflict between rights-of-way/mining		■	■	■	■

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-19. Comparison of Impacts by Alternative

SIGNIFICANT IMPACTS	No Action	Low Production	Moderate Production	High Production	Maximum Production
AIR QUALITY: Total suspended particulates (24 hr.)					
Sulfur dioxide concentrations (annual)					
GEOLOGY: Alterations to topography					
Conservation of coal resource					
WATER: Increased salinity in Fish & Trout creeks					
Increased salinity of Green River					
Increased salinity of Colorado River (Regional)					
Degradation of groundwater quality					
Increase in sediment yield of Albert Creek					
Reduction of flow in Separation Creek					
VEGETATION: Loss of scarce vegetation type					
WILDLIFE: Loss of sagebrush habitat					
Loss of big game winter habitat					
Loss of deer					
Loss of aquatic habitat of Fish & Trout creeks					
Loss of fisheries in Fish & Trout creeks					
Loss of raptor nests					
Loss of antelope					
Loss of elk					
Loss of riparian habitat					
Loss of sage grouse					
RECREATION: Urban recreation shortfall					
Degradation of visual resource management Class II					
LAND USE: Loss of grazing use					
ECONOMICS: Increased employment/income					
Increased revenues					
Community growth exceeding ability to pay for it					
Insufficient housing					
SOCIAL: Disruptive social change					
TRANSPORTATION: Increased community traffic					
Loss of life & property/increased accidents (Regional)					
Increased average daily county road traffic					
Increased average daily traffic Highway 40 & 13					
NOISE: Increased noise on Highway 40 & 13					
Increased noise on county roads used to haul coal					
UNKNOWN IMPACTS *					
GEOLOGY: Loss of fossils					
Subsidence potential					
WATER: Increased salinity of surface water					
Modification of groundwater flow					
Impact to Fish Creek alluvial valley floor					
Aquifer pollution from toxic by-products					
WILDLIFE: Loss of aspen habitat **					
Loss of big game winter habitat **					
Loss of elk **					
LAND USE: Impact of withdrawal on mining					
NOISE: Increased noise frequency from rail traffic					
OTHER FACTORS †					
Landslide potential					
Hazard: Methane					
No coal access on tract					
Mineability of tract					
Conflict between rights-of-way/mining					

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-20a. Northwest Colorado Subregion

SIGNIFICANT IMPACTS	Maximum Production				
	High Production				
	Moderate Production				
	Low Production			Rattle-snake Mesa	Signal Butte
	Prairie Dog	Little Middle Creek	Middle Creek		
AIR QUALITY: Total suspended particulates (24 hr.)					
Sulfur dioxide concentrations (annual)					
GEOLOGY: Alterations to topography					
Conservation of coal resource					
WATER: Increased salinity in Fish & Trout creeks					
Increased salinity of Green River					
Increased salinity of Colorado River (Regional)					
Degradation of groundwater quality					
Increase in sediment yield of Albert Creek					
Reduction of flow in Separation Creek					
VEGETATION: Loss of scarce vegetation type					
WILDLIFE: Loss of sagebrush habitat					
Loss of big game winter habitat					
Loss of deer					
Loss of aquatic habitat of Fish & Trout creeks					
Loss of fisheries in Fish & Trout creeks					
Loss of raptor nests					
Loss of antelope					
Loss of elk					
Loss of riparian habitat					
Loss of sage grouse					
RECREATION: Urban recreation shortfall					
Degradation of visual resource management Class II					
LAND USE: Loss of grazing use					
ECONOMICS: Increased employment/income					
Increased revenues					
Community growth exceeding ability to pay for it					
Insufficient housing					
SOCIAL: Disruptive social change					
TRANSPORTATION: Increased community traffic					
Loss of life & property/increased accidents (Regional)					
Increased average daily county road traffic					
Increased average daily traffic Highway 40 & 13					
NOISE: Increased noise on Highway 40 & 13					
Increased noise on county roads used to haul coal					
UNKNOWN IMPACTS *					
GEOLOGY: Loss of fossils					
Subsidence potential					
WATER: Increased salinity of surface water					
Modification of groundwater flow					
Impact to Fish Creek alluvial valley floor					
Aquifer pollution from toxic by-products					
WILDLIFE: Loss of aspen habitat **					
Loss of big game winter habitat **					
Loss of elk **					
LAND USE: Impact of withdrawal on mining					
NOISE: Increased noise frequency from rail traffic					
OTHER FACTORS †					
Landslide potential					
Hazard: Methane					
No coal access on tract					
Mineability of tract					
Conflict between rights-of-way/mining					

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown Impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other Factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

High Production

Table 2-20b. Northwest Colorado Subregion (cont.)

SIGNIFICANT IMPACTS

	Peck Gulch	Iles Mountain	Fish Creek	Bell Rock	Williams Fork Mountain	Lay Creek	Horse Gulch
AIR QUALITY: Total suspended particulates (24 hr.)							
Sulfur dioxide concentrations (annual)							
GEOLOGY: Alterations to topography							
Conservation of coal resource							
WATER: Increased salinity in Fish & Trout creeks							
Increased salinity of Green River							
Increased salinity of Colorado River (Regional)							
Degradation of groundwater quality							
Increase in sediment yield of Albert Creek							
Reduction of flow in Separation Creek							
VEGETATION: Loss of scarce vegetation type							
WILDLIFE: Loss of sagebrush habitat							
Loss of big game winter habitat							
Loss of deer							
Loss of aquatic habitat of Fish & Trout creeks							
Loss of fisheries in Fish & Trout creeks							
Loss of raptor nests							
Loss of antelope							
Loss of elk							
Loss of riparian habitat							
Loss of sage grouse							
RECREATION: Urban recreation shortfall							
Degradation of visual resource management Class II							
LAND USE: Loss of grazing use							
ECONOMICS: Increased employment/income							
Increased revenues							
Community growth exceeding ability to pay for it							
Insufficient housing							
SOCIAL: Disruptive social change							
TRANSPORTATION: Increased community traffic							
Loss of life & property/increased accidents (Regional)							
Increased average daily county road traffic							
Increased average daily traffic Highway 40 & 13							
NOISE: Increased noise on Highway 40 & 13							
Increased noise on county roads used to haul coal							
UNKNOWN IMPACTS *							
GEOLOGY: Loss of fossils							
Subsidence potential							
WATER: Increased salinity of surface water							
Modification of groundwater flow							
Impact to Fish Creek alluvial valley floor							
Aquifer pollution from toxic by-products							
WILDLIFE: Loss of aspen habitat **							
Loss of big game winter habitat **							
Loss of elk **							
LAND USE: Impact of withdrawal on mining							
NOISE: Increased noise frequency from rail traffic							
OTHER FACTORS †							
Landslide potential							
Hazard: Methane							
No coal access on tract							
Mineability of tract							
Conflict between rights-of-way/mining							

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-21. South-Central Wyoming Subregion

SIGNIFICANT IMPACTS	Maximum Production					
	High Production				Northeast Cow Creek	
	Moderate Production			Indian Springs		
	Atlantic Rim	Corral Canyon	Wild Horse Draw			
AIR QUALITY: Total suspended particulates (24 hr.)						
Sulfur dioxide concentrations (annual)						
GEOLOGY: Alterations to topography						
Conservation of coal resource						
WATER: Increased salinity in Fish & Trout creeks						
Increased salinity of Green River						
Increased salinity of Colorado River (Regional)						
Degradation of groundwater quality						
Increase in sediment yield of Albert Creek						
Reduction of flow in Separation Creek						
VEGETATION: Loss of scarce vegetation type						
WILDLIFE: Loss of sagebrush habitat						
Loss of big game winter habitat						
Loss of deer						
Loss of aquatic habitat of Fish & Trout creeks						
Loss of fisheries in Fish & Trout creeks						
Loss of raptor nests						
Loss of antelope						
Loss of elk						
Loss of riparian habitat						
Loss of sage grouse						
RECREATION: Urban recreation shortfall						
Degradation of visual resource management Class II						
LAND USE: Loss of grazing use						
ECONOMICS: Increased employment/income						
Increased revenues						
Community growth exceeding ability to pay for it						
Insufficient housing						
SOCIAL: Disruptive social change						
TRANSPORTATION: Increased community traffic						
Loss of life & property/increased accidents (Regional)						
Increased average daily county road traffic						
Increased average daily traffic Highway 40 & 13						
NOISE: Increased noise on Highway 40 & 13						
Increased noise on county roads used to haul coal						
UNKNOWN IMPACTS *						
GEOLOGY: Loss of fossils						
Subsidence potential						
WATER: Increased salinity of surface water						
Modification of groundwater flow						
Impact to Fish Creek alluvial valley floor						
Aquifer pollution from toxic by-products						
WILDLIFE: Loss of aspen habitat **						
Loss of big game winter habitat **						
Loss of elk **						
LAND USE: Impact of withdrawal on mining						
NOISE: Increased noise frequency from rail traffic						
OTHER FACTORS †						
Landslide potential						
Hazard: Methane						
No coal access on tract						
Mineability of tract						
Conflict between rights-of-way/mining						

NOTE: ■ represents a significant impact, ▲ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

Table 2-22. Southwest Wyoming Subregion

High and Maximum Production						
Moderate Production						
Low Production						
Deadman	Leucite Hills	Point of Rocks	Tract 98	Byrne Creek	Pio	Winton

NOTE: ■ represents a significant impact, ▒ an impact contributing to a significant impact but not significant in itself.

* Unknown impacts are impacts whose magnitude and extent are not known but which represent potential problem areas.

** Pending ongoing elk habitat use study.

† Other factors could be potential problem areas even though they do not represent impacts to the specific resources analyzed in this EIS.

CHAPTER 3

AFFECTED ENVIRONMENT

INTRODUCTION

The following sections describe the affected environment by resource or environmental component. Environmental components projected in Chapter 4 to receive the most important or significant impacts are given the most attention. Information given is based on the best data available, with professional judgment being used when needed to fill in information gaps. The affected environment described is contained within a seven-county area of the Green River-Hams Fork region, which includes all of the coal tracts. Depending on the resource or impact area of the resource, the affected environment as described in a particular resource section may be smaller than the seven-county area.

There are no designated areas of critical environmental concern, or ACECs, for any resource either in or adjacent to any of the proposed lease areas.

CLIMATE AND AIR QUALITY

Climate

The Green River-Hams Fork study area is located in a semi-arid, continental climate regime characterized by dry air, sunny days, clear nights, little precipitation, high evaporation, and large diurnal temperature changes. The region's complex topography creates considerable variation in site-specific temperature, precipitation, and surface winds; these influences are generally less on the plateaus than in the valleys. Extremely frigid conditions and blizzards can occur, but severe weather conditions such as tornadoes, floods, and damaging hail are rare. Table 3-1 summarizes monitored values for temperature, precipitation, and frost-free periods in the study area, and figure 3-1 indicates the distribution of surface winds in the Craig, Rawlins, and Rock Springs subregions.

The extent to which vertical and horizontal mixing will take place is related to atmospheric stability and mixing height. Distributions of these factors from selected locations in the study area are presented in table 3-2. Unstable conditions occur under conditions of strong surface heating, typical

of summer afternoons producing upslope winds. Neutral conditions reflect a breezy, well-mixed atmosphere. Stable conditions are enhanced by rapid radiative cooling and downslope drainage, producing the least amount of dispersion.

Inversions are formed under stable conditions, trapping pollutants within a certain layer of air. Moderate inversions are typical during summer evenings and dissipate at dawn. Winter inversions are stronger and last longer. Inversions are enhanced by weak pressure gradients, cold clear nights, snowcover, and lower elevations.

In general, the average afternoon dispersion capability is better and the average morning dispersion capacity relatively poor when compared with other regions throughout the nation. Tract-specific climatology is reported in each site-specific analysis (Radian Corporation 1983a); detailed climatic data have been reported by Pedco Environmental, Inc. (1981) and Science Applications, Inc. (1980). The following discussions characterize the climate in the three subregions analyzed.

Craig Subregion

Temperatures vary mostly with elevation, and to a lesser extent, local microclimate. Table 3-1 portrays both temperature and precipitation data for the Craig subregion.

Upper-level winds predominate from the southwest, but surface wind patterns vary with local terrain and ground cover. The predominant winds measured in Craig, Colorado, are from the southwest at nearly 3 meters per second. Persistent winds with little directional modification are found on the plateaus, but winds in valleys show strong drainage influences. Synoptic (pressure gradient) winds may be forced around hills or channeled through valleys, but if there are no strong gradient flows, diurnal upslope/downslope winds predominate. Upslope winds usually occur on sunny mornings when the air at higher elevations heats rapidly and rises. Downslope winds occur when the air near the ground cools, becomes dense, and sinks downward along drainages.

Air basins have been defined based on these drainage winds, indicating areas of similar atmospheric flow, topographic influence, and general dispersion potential. Under stable conditions, pollut-

TABLE 3-1

SELECTED CLIMATIC DATA

Station	Elevation (m)	Temperature (°F)					Precipitation (In.)				Frost-Free Periods		
	Mean Sea Level	Extreme Min	Mean Min	Annual Mean	Mean Max	Extreme Max	Annual Mean	Monthly Max	Monthly Min	Mean Snowfall	# Days	Mean Begin Date	Mean End Date
<u>Craig Subregion</u>													
Craig	1915	-45	27	42	58	99	13.4	1.6	0.8	85	97	6/8	9/10
Little Hills	1870	-48	25	43	61	97	12.9	1.7	0.7	52	59	6/23	8/21
Marvine	2240	-40	25	41	56	95	20.5	2.2	1.4	179	(43)	-	-
Yampa	2405	-24	25	39	54	88	16.0	2.1	1.1	120	(43)	-	-
<u>Rawlins Subregion</u>													
Rawlins	2065	-36	30	42	55	93	8.8	1.2	0.5	53	106	6/1	9/15
Seminole Dam	2085	-33	31	43	55	98	12.7	2.0	0.6	(53)	117	5/27	9/2
<u>Rock Springs Subregion</u>													
Evans ton	2090	-38	24	40	55	96	11.0	1.7	0.7	(42)	47	6/21	8/7
Kemmerer	2120	-33	25	39	54	98	9.4	1.4	0.6	(42)	61	6/17	8/15
Rock Springs	2055	-37	31	43	58	96	8.9	1.1	0.4	41	111	5/29	9/18

SOURCES: PEDCO Environmental, Inc., 1981; Radlan Corporation, 1983a; and Science Applications, Inc., 1980.

NOTE: Values in parentheses are representative of, but not actually monitored at, the indicated station.

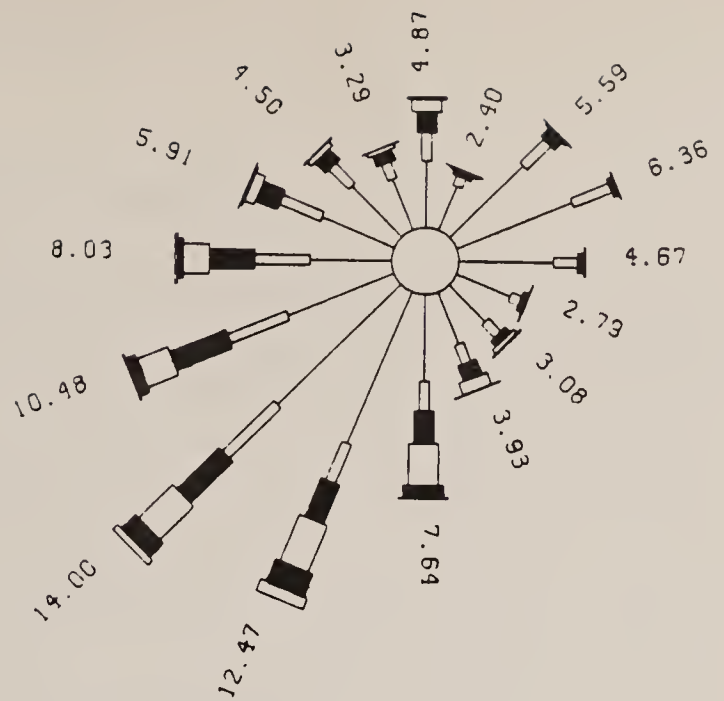


FIGURE 2-1. ANNUAL WIND ROSE FOR CRAIG, COLORADO
Period of Record: 1981

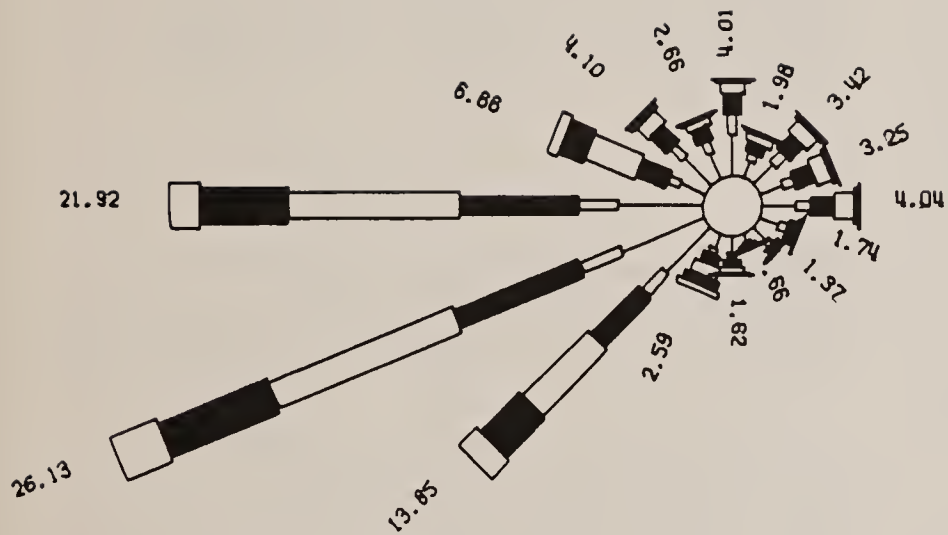
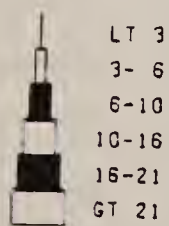


Figure 2-1. Annual Wind Rose for Rawlins, Wyoming
Period of Record: 1955-1964

WIND SPEED
(KNOTS)



0 PCT 5 PCT 10 PCT

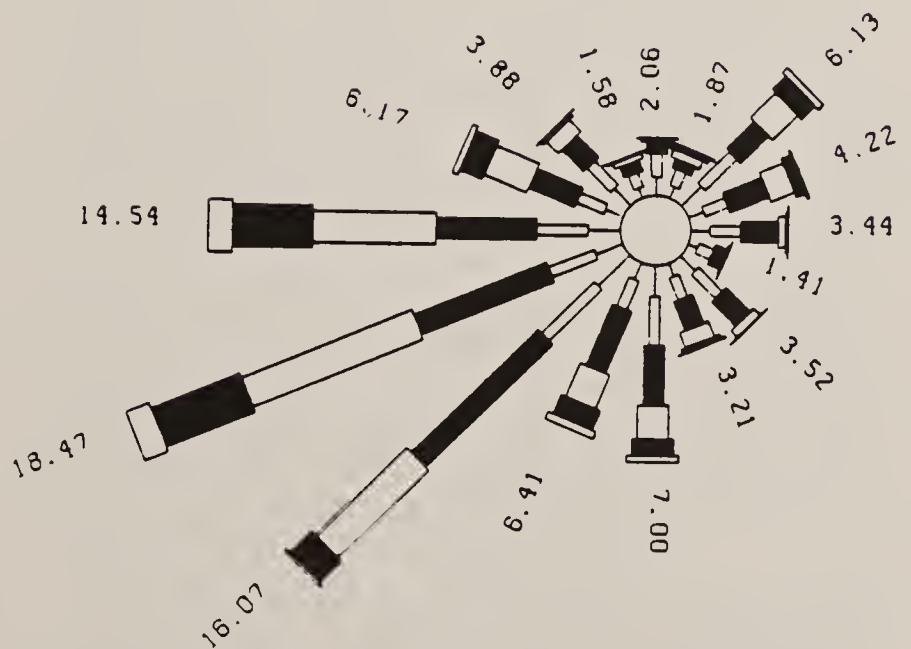


FIGURE 2-1. ANNUAL WIND ROSE FOR
ROCK SPRINGS, WYOMING

Period of Record: 1960-1964

Figure 3-1. Surface Wind Roses
Source: Radian Corporation, 1983

TABLE 3-2
SELECTED ATMOSPHERIC DISPERSION VALUES

Station	Season	Stability Frequency (percent)			Approx. Mixing Height (m)	
		Unstable	Neutral	Stable	Morning	Afternoon
Craig	Annual	9	51	40	380	2540
	Spring	18	55	27	610	3080
	Summer	7	43	50	340	3770
	Fall	7	53	40	240	2120
	Winter	3	54	43	320	1170
Rawlins	Annual	13	58	29	360	2410
	Spring	11	65	24	560	2920
	Summer	27	39	34	320	3560
	Fall	10	56	34	260	2060
	Winter	4	72	24	290	1090
Rock Springs	Annual	16	52	32	360	2350
	Spring	15	60	25	540	2790
	Summer	29	36	35	310	3630
	Fall	15	50	35	290	2000
	Winter	9	56	35	320	990

SOURCES: Radian Corporation, 1983a; Science Applications, Inc., 1980.

AFFECTED ENVIRONMENT

ants tend to collect and concentrate in an air basin until regional synoptic winds disperse the air between basins. Generally, downslope winds around the proposed tracts flow into the Craig Air Basin.

Rawlins Subregion

Temperatures vary minimally throughout the subregion, with some variation due to differences in elevation. Temperature and precipitation data are presented in table 3-1.

Upper level winds predominate from the west and west-southwest. Surface level winds also reflect this predominance, averaging 5 meters per second from the west-southwest. Drainage winds are limited to relatively few specific areas. Generally, downslope winds around the proposed tracts flow into the Laramie and Great Divide air basins.

Rock Springs Subregion

Elevation effects vary temperature minimally throughout the subregion. Table 3-1 shows both temperature and precipitation data for the Rock Springs subregion.

Surface level winds reflect the upper level west and west-southwesterly flow. Some channeling is evident due to the lower terrain between Green River and Rock Springs. Secondary maxima shown in the Rock Springs Wind Rose (figure 3-1) result from local nocturnal drainage flow. Winds average 5 meters per second from the west-southwest. Proposed tracts within this subregion are located in the Sublette Air Basin.

Air Quality

The existing air quality of the Green River-Hams Fork study area is typical of undeveloped regions in the Western United States; ambient pollutant levels are usually near or below the measurable limits. Notable exceptions in this region include high, short-term concentrations of total suspended particulates (related to local winds), and possibly ozone and carbon monoxide, especially in towns. Locations vulnerable to decreasing air quality from extensive energy-related resource development include the immediate operation areas (coal mines, shale oil retorts, etc.), local population centers with their induced impacts, and distant areas which can be affected through long-range transport of pollutants.

Air Quality Regulations

National ambient air quality standards limit the total amounts of specific pollutants (carbon monoxide, lead, nitrogen dioxide, ozone, sulfur dioxide, and total suspended particulates) allowed in the atmosphere. State standards include these parameters but may also be more stringent (i.e., Colorado's three-hour sulfur dioxide standard) or regulate other pollutants (i.e., Wyoming's hydrogen fluoride and hydrogen sulfide standards). These standards were established to protect public health (primary standards) and public welfare (secondary standards). Areas which consistently violate minimum Federal standards because of human activities are classified as nonattainment areas, and must implement a plan to reduce ambient levels below the maximum pollution standards (table 3-3). Under the Environmental Protection Agency's Fugitive Dust Policy, areas which violate the total suspended particulates ambient air quality standards but lack any significant industrial particulate sources and have a population less than 25,000 are designated as unclassified (i.e., neither attainment nor nonattainment). Unclassified areas are generally exempt from having to follow the offset provisions, retrofit controls, and new source control requirements established for nonattainment areas by the Clean Air Act.

To protect areas designated as attainment or unclassified, Congress established a system for the Prevention of Significant Deterioration (PSD) through the Clean Air Act Amendments of 1977. Areas were classified by the additional amounts of total suspended particulates and sulfur dioxide degradation which would be allowed. PSD Class I areas, predominately national parks and certain wilderness areas, have the greatest limitations; virtually any degradation would be significant. Areas where moderate, controlled growth can take place were designated as PSD Class II. PSD Class III areas are those areas which allow the greatest degree of impacts. Most of the study region is PSD Class II. The state of Wyoming implemented this program, whereas Colorado established a similar program limiting additional amounts of sulfur dioxide; Colorado's lands are classified Category I, Category II, and Category III (corresponding to increasing permissible levels of sulfur dioxide).

The current PSD regulations apply to coal mines only if over 250 tons of a regulated pollutant are emitted annually via a stack or vent (controllable source). Since fugitive emission sources are therefore not considered, and since most mines do not have a large, adjacent processing facility, it is unlikely that the proposed mines would be subject to the PSD regulations. However, specific determina-

TABLE 3-3

STATE AND FEDERAL AIR QUALITY STANDARDS (micrograms per cubic meter)

Pollutant	Averaging Time	Ambient**					Increment †					
		Federal		Colorado		Wyoming State	Federal & Wyoming			Colorado		
		Primary	Secondary	Primary	Secondary		Class	Class	Class	Category	Category	Category
							I	II	III	I	II	III
Carbon Monoxide	8 hour	10,000	10,000	10,000	--	10,000	--	--	--	--	--	--
	1 hour	40,000	40,000	40,000	--	40,000	--	--	--	--	--	--
Non-Methane Hydrocarbons	3 hour (0600-0900)	--	--	--	--	160	--	--	--	--	--	--
Hydrogen Fluoride	24 hour	--	--	--	--	0.8	--	--	--	--	--	--
Hydrogen Sulfide	long-term ††	--	--	--	--	70	--	--	--	--	--	--
	short-term *	--	--	--	--	40	--	--	--	--	--	--
Lead	Quarterly	1.5	1.5	--	--	--	--	--	--	--	--	--
Nitrogen Dioxide	Annual (Arith.)	100	100	100	--	100	--	--	--	--	--	--
Oxidants (Ozone)	1 hour	235	235	160	--	160	--	--	--	--	--	--
Sulfur Dioxide	Annual (Arith.)	80	--	--	--	60	2	20	40	2	10	15
	24 hour	365			--	260	5	91	182	5	50	100
	3 hour	--	1,300	700	--	1,300	25	512	700	25	300	700
Total Suspended Particulates	Annual (Geom.)	75	60	75	60**	60	5	19	37	--	--	--
	24 hour	260	150	260	150	150	10	37	75	--	--	--

SOURCES: National Primary and Secondary Ambient Air Quality Standards (40 CFR 50 et seq., as amended January 5, 1983).

Requirements for Preparation, Adoption and Submittal of Implementation Plans (40 CFR 51.24, as amended September 3, 1982).

Approval and Promulgation of Implementation Plans (40 CFR 52.21, as amended June 25, 1982).

Code of Colorado Regulations (Volume 5, Part 14 as amended May 27, 1980).

Wyoming Rules and Regulations of the Department of Environmental Quality, Air Quality Division, (Chapter 1 as amended January 25, 1979).

* Short-term standards (those other than Annual and Quarterly) are not to be exceeded more than once each year, except hydrogen fluoride, hydrogen sulfide, and the Federal ozone standards. Under Federal regulations, the "expected number of days" with ozone levels above the standard are not to be exceeded more than once per calendar year.

** Ambient standards are the absolute maximum level allowed to protect either public health (primary) or welfare (secondary).

† Incremental (Prevention of Significant Deterioration) standards are the maximum incremental amounts of pollutants allowed above the baseline in regions of clean air.

†† The Wyoming long-term hydrogen sulfide half-hour standard is not to be exceeded more than twice per calendar year.

* The Wyoming short-term hydrogen sulfide half-hour standard is not to be exceeded twice per five day period.

** The Colorado annual secondary TSP standard was established as a guide in assessing implementation plans to achieve the 24-hour standard.

AFFECTED ENVIRONMENT

tion of applicability would need to be made once specific mining plans were developed.

Higher total suspended particulate concentrations are to be expected near towns due to local combustion sources and unpaved roads. Significant regional total suspended particulate levels are probably due to fugitive dust (primarily wind-blown). Since fugitive dust particulates are larger than those produced in combustion processes, they settle relatively quickly and present a minimal inhalation health threat. The Environmental Protection Agency has recognized this difference by developing standards for particulates less than 10 microns in diameter, commonly called inhalable particulates and abbreviated PM-10; however, these standards have not yet been implemented.

Ozone levels in the Rocky Mountain West are relatively high but of unknown origin. Elevated concentrations may be a result of long-range transport from urban areas, subsidence of stratospheric ozone, or photochemical reactions with natural hydrocarbons. The true reason for elevated ozone values is uncertain, however. Occasional peak concentrations of carbon monoxide and nitrogen dioxide may be caused by combustion equipment near monitors.

PSD Class I regulations also address the potential for impacts to "air quality related values." These values include visibility, odors, and impacts to flora, fauna, soils, water, and geologic and cultural structures. Visibility impacts can occur from atmospheric increases in small, light-scattering particles or increases in light absorbing gases (typically nitrogen dioxide). A possible source of impact to air quality related values is acid precipitation. Mechanisms of acid precipitation formation are currently under study; preliminary results have correlated ambient sulfuric and nitric acids with combustion by-products (sulfates and nitrates). Due to the nature of potential coal mining emissions, it is unlikely that direct impacts to "air quality related values" would occur.

Existing Air Quality

Average and extreme background concentrations of total suspended particulates, sulfur dioxide, and nitrogen dioxide in the study area are presented in table 3-4. Although monitoring data for carbon monoxide, lead, and ozone near the proposed lease tracts are limited, levels are estimated to be low and within standards (Radian Corporation 1983a). Tables 3-5 and 3-6 summarize the existing levels of visibility and acid deposition in the vicinity of the study region. The following discussions characterize existing air quality in the three subregions analyzed.

Craig Subregion

Gaseous pollutant monitoring is limited in the subregion, but levels are estimated to be low and within standards. In the vicinity of the Bell Rock, Horse Gulch, Iles Mountain, Lay Creek, Peck Gulch, Signal Butte, and Williams Fork Mountain proposed lease tracts, the total suspended particulate annual geometric mean concentration is estimated at 20 micrograms per cubic meter and the 24-hour geometric mean is estimated at 80 micrograms per cubic meter. Ambient total suspended particulate concentrations at the Fish Creek, Little Middle Creek, and Middle Creek tracts are estimated to be 21 and 90 micrograms per cubic meter for the annual and 24-hour geometric means, respectively. Annual concentrations are estimated to be 18 micrograms per cubic meter at the Prairie Dog and Rattlesnake Mesa proposed lease tracts, whereas 24-hour geometric mean values are estimated to be 80 micrograms per cubic meter.

Most of the subregion has been designated a PSD Class II attainment area. Some towns have measured high particulate levels (exceeding the standards), but since the cause is primarily natural fugitive dust, these towns have been designated unclassified. The nearest PSD Class I areas are the Flat Tops and Mount Zirkel wilderness areas; Dinosaur National Monument has been proposed for PSD Class I status (Figure 3A) but is currently PSD Class II.

Rawlins Subregion

Virtually no gaseous pollutant data have been collected in the subregion, but pollutant concentrations are believed to be within standards. Estimated ambient concentrations for all proposed lease tracts (Atlantic Rim, Corral Canyon, Indian Springs, Northeast Cow Creek, and Wild Horse Draw) are 34 micrograms per cubic meter for the annual geometric mean and 45 micrograms per cubic meter for the 24-hour geometric mean. All of the Rawlins subregion is in the attainment category and is classified PSD Class II. Mount Zirkel Wilderness Area is the closest PSD Class I area.

Rock Springs Subregion

Pollutant data indicate ambient levels are within standards, with the exception of high total suspended particulate values in areas of trona development and within urban areas (primarily due to fugitive dust). Annual geometric mean particulate values near the proposed Byrne Creek and Tract 98 lease sites are 17 micrograms per cubic meter. Values in the vicinity of the proposed Deadman, Leucite Hills,

TABLE 3-4

SELECTED AMBIENT POLLUTANT CONCENTRATION DATA
(micrograms per cubic meter)

Station Name/Type	Year	Total Suspended Particulates				Sulfur Dioxide				Nitrogen Dioxide	
		# Obs	Ann	1st	2nd	# Obs	Ann	1st	1st	# Obs	Ann
			Geo Mean	24-hr Max	24-hr Max		Arith Mean	24-hr Max	3-hr Max		Arith Mean
Craig Subregion											
Craig/Urban	1981	83	87	--	230						
	1980	71	86	--	238						
Craig Power Plant/Rural	1981	--	26	--	76						
Colowyo/Rural	1977/76	--	26	--	90						
Hayden/Rural	1976	66	30	522	165						
Meeker/Urban	1981	77	59	--	134						
	1980	70	66	--	171						
Oak Creek/Rural	1981	--	33	169	120						
	1980	--	38	180	169						
Rangley/Urban	1981	66	68	--	172						
	1980	20	(60)	--	132						
Rienau/Rural	1981	--	30	--	97						
Utah Int'l/Rural	1978	46	23	--	--						
	1977	48	31	--	--						
Rawlins Subregion											
Casper/Urban	1981					57	4	37	--	58	40
	1980					57	3	19	--	59	51
Adams Ranch/Rural	1981	39	26	140	76						
Energy Devel./Rural	1981	47	59	248	205						
Espy Ranch/Rural	1981	29	(19)	64	52						
Hanna/Urban	1981	52	56	125	118						
	1980	58	67	(228)	(218)						

TABLE 3-4
(Continued)

SELECTED AMBIENT POLLUTANT CONCENTRATION DATA
(micrograms per cubic meter)

Station Name/Type	Year	Total Suspended Particulates				Sulfur Dioxide				Nitrogen Dioxide	
		#	Ann Geo Mean	1st 24-hr Max	2nd 24-hr Max	#	Arith Mean	1st 24-hr Max	1st 3-hr Max	#	Ann Arith Mean
Rock Springs Subregion											
Evanson/Urban	1978	42	43	137	136						
	1977	51	47	167	<u>165</u>						
Fearn/Urban	1980	47	<u>142</u>	(1,149)	<u>360</u>	60	1	7	--	61	60
	1979	38	<u>94</u>	270	<u>261</u>	60	2	18	--	58	35
Granger/Rural	1978	55	29	121	104						
	1977	58	32	102	90						
Green River/Rural	1981	16	(45)	90	75						
Bridger Power Plant/Rural	1981	--	40	131	101						
Kemmerer/Urban	1978	17	(25)	53	40	--	1	5	--	--	9
	1977	16	(17)	39	30						
Landeen/Urban	1981	56	<u>83</u>	234	<u>180</u>						
	1980	57	<u>105</u>	(522)	(405)						
Naughton Power Plant/Rural	1976	33	34	78	77	--	3	26	105		
	1975	46	24	69	58						

SOURCE: Radian Corporation, 1983a

NOTE: Values in parentheses lack reliability due to limited sample size and/or abnormal sampling conditions (construction activities, etc.) Underlined values indicate violation of Ambient Air Quality Standards.

TABLE 3-5

SELECTED VISUAL RANGE DATA
(kilometers)*

Season	Dinosaur Nat'l Monument	Craig, Colorado	Rawlins Subregion**	Rock Springs Subregion**
Spring 1980	†	93/142/216		
Summer 1980	95/150/238	104/136/179		
Fall 1980	146/203/283	96/144/217	110-170	110-170
Winter 1981	†	113/170/258		
Spring 1981	†	107/166/257		
Summer 1981	95/135/192	94/140/209		
Fall 1981	†	98/154/241		
Winter 1982		77/127/207		
Spring 1982		115/175/268		
Summer 1982		110/160/234		

SOURCE: John Muir Institute, n.d. Teleradiometer measurements are taken daily of several targets and adjusted to a standard visual range elevation of 1550 m.

* Data are presented as 10th/50th/90th percentile values.

** Rawlins and Rock Springs subregion values estimated from the EPA Workbook for Estimating Visibility Impairment (Latimer and Ireson, 1980).

† Insufficient data.

TABLE 3-6
SELECTED ATMOSPHERIC PRECIPITATION DATA (pH)

Season	Craig, Colorado				Marvine Ranch, CO				Pinedale, Wyoming			
	#		1st	2nd	#		1st	2nd	#		1st	2nd
	Obs	Mean	Min	Min	Obs	Mean	Min	Min	Obs	Mean	Min	Min
Spring 1980/81	26	4.90	4.30	4.33	7	5.59	4.86	5.47				
Summer 1980/81	21	4.88	4.32	4.45	7	4.81	4.49	4.74				
Fall 1980/81	17	5.03	4.62	4.70	5	4.86	4.39	4.85				
Winter 1982	6	5.43	5.04	5.20					5	5.01	4.85	4.96
Spring 1982									13	5.50	4.74	5.18
Summer 1982									13	5.21	4.62	4.73

SOURCE: Natural Resource Ecology Laboratory, n.d., and Turk, J.T., 1982.



Map 3-A. Air Quality/Climate Monitoring Locations and Sensitive Areas

AFFECTED ENVIRONMENT

Point of Rocks and Winton lease tracts are estimated to be 35 micrograms per cubic meter annually; annual values near the Pio Tract are believed to be 38 micrograms per cubic meter. The 24-hour geometric mean values are estimated to be 45 micrograms per cubic meter throughout the subregion. Most of the Rock Springs subregion is designated PSD Class II attainment, but some towns are unclassified due to high fugitive total suspended particulate levels. The area of Sweetwater County around the Trona mines are classified nonattainment. The closest PSD Class I area is the Bridger Wilderness Area. Fossil Butte and Dinosaur national monuments, and the Scab Creek, High Uintas, and Popo Agie primitive areas have all been recommended for PSD Class I status; these are currently PSD Class II areas.

GEOLOGY, TOPOGRAPHY, AND MINERALS

Physiography and Topography

Physiographic provinces are regions of similar structure and climate that have had a unified geomorphic history. The Green River-Hams Fork Coal Region encompasses portions of four physiographic provinces: the Southern Rocky Mountain, Wyoming Basin, Colorado Plateau, and Middle Rocky Mountain. These provinces, in turn, are subdivided into structural basins and uplifts (mountains, ridges, etc.). Figure 3-2 illustrates the locations of the proposed lease tracts with respect to the structural basins and uplifts of the region.

The Colorado portion of the coal tracts is located in Moffat, Routt, and Rio Blanco counties. Routt and Moffat counties include the Sand Wash structural basin and the Axial Basin uplift, which includes the Williams Fork Mountains. The area is known as the Yampa coal field and is characterized by low mountain ranges, rolling hills, and broad valleys. Altitudes generally range between 6,000 and 8,000 feet. More subdued land forms are present northward in the Sand Wash Basin, owing to less resistant late Cretaceous and Tertiary aged strata. Drainage is generally westward to the Yampa River.

Coal tracts in Rio Blanco County are within the Danforth Hills and Lower White River coal fields. The Danforth Hills coal field is separated from the Yampa coal field to the north by Axial Basin, a topographic low that trends southeast-northwest. The Danforth Hills are characterized by steep south-facing escarpments and gentler north-facing dip

slopes. Elevations range from about 6,500 to 8,500 feet.

The Lower White River coal field is about 50 miles west of Danforth Hills. The field includes the northwestern Piceance Basin and northern portion of the Douglas Creek arch. The Lower White River field has broad open plains with low relief, interrupted by long and wide-to-narrow ridges and by some moderately hilly land and mesas. Elevations range from about 5,200 to 7,700 feet.

The Wyoming portion of the coal tracts is located in Carbon, Sweetwater, Uinta, and Lincoln counties. Coal tracts in Carbon and Sweetwater counties are located in the Rock Springs and Rawlins uplifts and in the Hanna and Washakie basins. The Uinta and Lincoln counties' coal tracts are located in the Overthrust Belt of the Middle Rocky Mountain physiographic province.

The Hanna Basin is characterized by sagebrush covered high plains that are topographically broken around the margin by low ridges composed of resistant sandstone. Elevations range from 7,000 to 7,900 feet. The Rawlins uplift has rugged topography, with altitudes ranging from 6,400 to 7,800 feet.

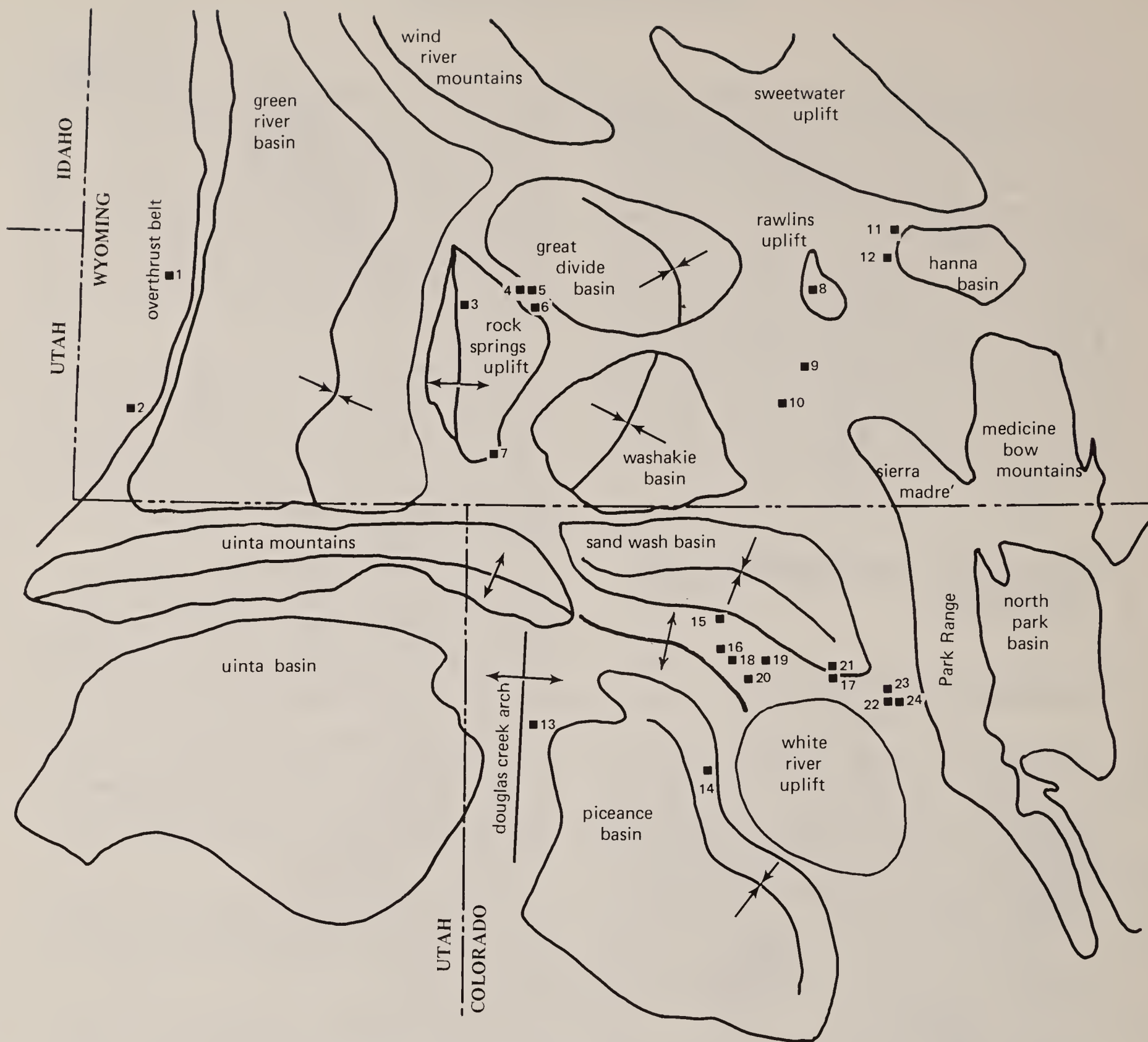
The Washakie Basin is characterized by sagebrush covered low rolling hills, high rock rims on the north and southwest, and broad shallow valleys. Elevations range from about 6,100 feet near the Little Snake River in the Southeast to about 8,700 feet on the west margin.

The Rock Springs uplift is composed of a central basin surrounded by ridges and mountains that dip into the surrounding basins. Elevations range from about 6,400 to over 8,600 feet (Welder and McGreery 1966).

The Overthrust Belt is characterized by north-south trending mountains and valleys formed from linear folds and faults (USDI BLM 1978). Elevations range from about 6,800 to 7,400 feet. Drainage is eastward by Blacks Fork and Hams Fork to the Green River.

Stratigraphy

Sedimentary rocks outcropping around the margins of the uplifts and basins within the Green River-Hams Fork EIS region range in age from Cambrian thru Tertiary. There are approximately 150 named stratigraphic units (i.e., groups, formations, members, tongues, etc.) within the region. The distribution, correlation, and description of the regional stratigraphic framework can be found in USDI BLM (1976, 1978a, 1978b, and 1980), Welder



■ PROPOSED COAL LEASE TRACTS

WYOMING

TRACT 98	1
BYRNE CREEK	2
WINTON	3
LEUCITE HILLS	4
DEADMAN	5
POINT OF ROCKS	6
PIO	7
INDIAN SPRINGS	8
ATLANTIC RIM	9
NE COW CREEK	10
CORRAL CANYON	11
WILD HORSE DRAW	12

COLORADO

PRAIRIE DOG	13
RATTLESNAKE	14
LAY CREEK	15
SIGNAL BUTTE	16
PECK GULCH	17
HORSE GULCH	18
BELL ROCK	19
ILES MOUNTAIN	20
WILLIAMS FORK	21
LITTLE MIDDLE CREEK	22
FISH CREEK	23
MIDDLE CREEK	24

0 100 MILES

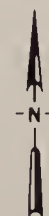


Figure 3-2. Generalized Tectonic Map Showing Location of Green River/Hams Fork Coal Lease Tracts

AFFECTED ENVIRONMENT

and McGreery (1966), Root and others (1973), Tweto (1976), and Rowley and others (1979).

Coal-bearing sequences of economic interest in the Green River-Hams Fork Coal Region are the Mesa Verde Group, the Lance Formation, and the Adaville Formation of Cretaceous age and the Fort Union Formation of Paleocene age.

The Cretaceous coal sequences were deposited along the western margin of the Interior Cretaceous Seaway. The shoreline fluctuated during the late Cretaceous, resulting in a complex intertonguing of sandstones, siltstones, and shales, with coal seams formed from peat deposited in swamps and lagoons. Tertiary coal was formed from peat deposited on alluvial plains in a continental-fluvial environment.

The regional correlation of upper Cretaceous and Tertiary strata is illustrated in figure 3-3. As can be seen in the correlation chart, the Mesa Verde Group is divided into different stratigraphic units in both Wyoming (Blair, Rock Springs, Ericson, and Almond formations) and Colorado (Iles and Williams Fork formations) because of intertonguing and the application of different names for strata, depending on their geographic location.

Structure

Major structural features of the coal region are products of the Laramide orogeny, a period of mountain building that began at the close of the Cretaceous Period. The region consists of a number of structural basins separated from each other by uplifts (figure 3-2). The structure of the Green River, Great Divide, Piceance, and Uinta basins has no bearing on the coal tracts and will not be discussed.

The Overthrust Belt is a structurally complex zone of dominantly eastward thrust faulted strata with associated folding that resulted in the development of parallel mountain ranges and synclinal valleys (USDI BLM 1976 and USDI BLM 1978a). The Rock Springs uplift separates the Green River Basin on the west from the Washakie Basin on the east. A 40-mile long, north-south trending, doubly plunging anticline, it is the largest uplift in Wyoming that does not have Precambrian rocks exposed in its core. The uplift is asymmetric, with dips up to 35 degrees on the west limb and only 4 to 8 degrees on the east, and is cut by numerous east-northeast trending high angle normal and reverse faults.

The Washakie Basin is a shallow (about 25,000 feet to the Precambrian) and nearly symmetrical synclinal structure located south of the Great Divide Basin and north of the Sand Wash Basin. Strata

generally dip at about 2 to 12 degrees toward the center of the basin (Welder and McGreery 1966).

The Rawlins uplift is a northwest trending asymmetric anticline with dips ranging from near vertical on the west limb to between 10 and 20 degrees on the east limb. The Hanna Basin is one of the deepest (38,000 to 40,000 feet to the Precambrian) closed sedimentary basins in North America (USDI BLM 1978b).

The Sand Wash Basin generally trends northwest-southeast and is bounded by the Park Range uplift on the east. The Williams Fork Mountains/Axial Basin define the southern boundary of the basin. They consist of en echelon folds that dip northward into the basin and rise southward to the White River uplift. The Douglas Creek arch is a north-plunging anticline on the Precambrian basement and is characterized by a series of northwest striking en echelon folds in the overlying sedimentary cover. The arch separates the Piceance Basin on the east from the Uinta Basin to the west (Haun 1962).

Paleontology

Vertebrate, invertebrate, and botanical fossils occur within coal-bearing strata of the region. The type of fossils present is dependent on the depositional environment and effectiveness of preservation. Vertebrate and botanical fossils are associated with continental deposits of late Mesozoic and Cenozoic age, while invertebrate and trace fossils are usually associated with marine deposits.

The region has not been intensively inventoried for paleontological resources. However, surveys that have been done in both Wyoming and Colorado have found significant assemblages of vertebrate fauna. A paleontological survey conducted for the Bureau (Lucas and Kihm 1982) identified "abundant and hitherto unknown paleontologic locales, many of which are judged to be highly significant to significant" within the Williams Fork Formation in northwest Colorado. Fossil remains of vertebrates were identified during premining survey of the Leucite Hills Mine in the Almond Formation in Wyoming (Rocky Mountain Energy 1980).

Geologic Hazards

Faulting is common in the coal region and is associated with the structural uplifts and the Overthrust Belt. The region is considered, as a whole, to be in a zone of low seismicity (USDI BLM 1978a).

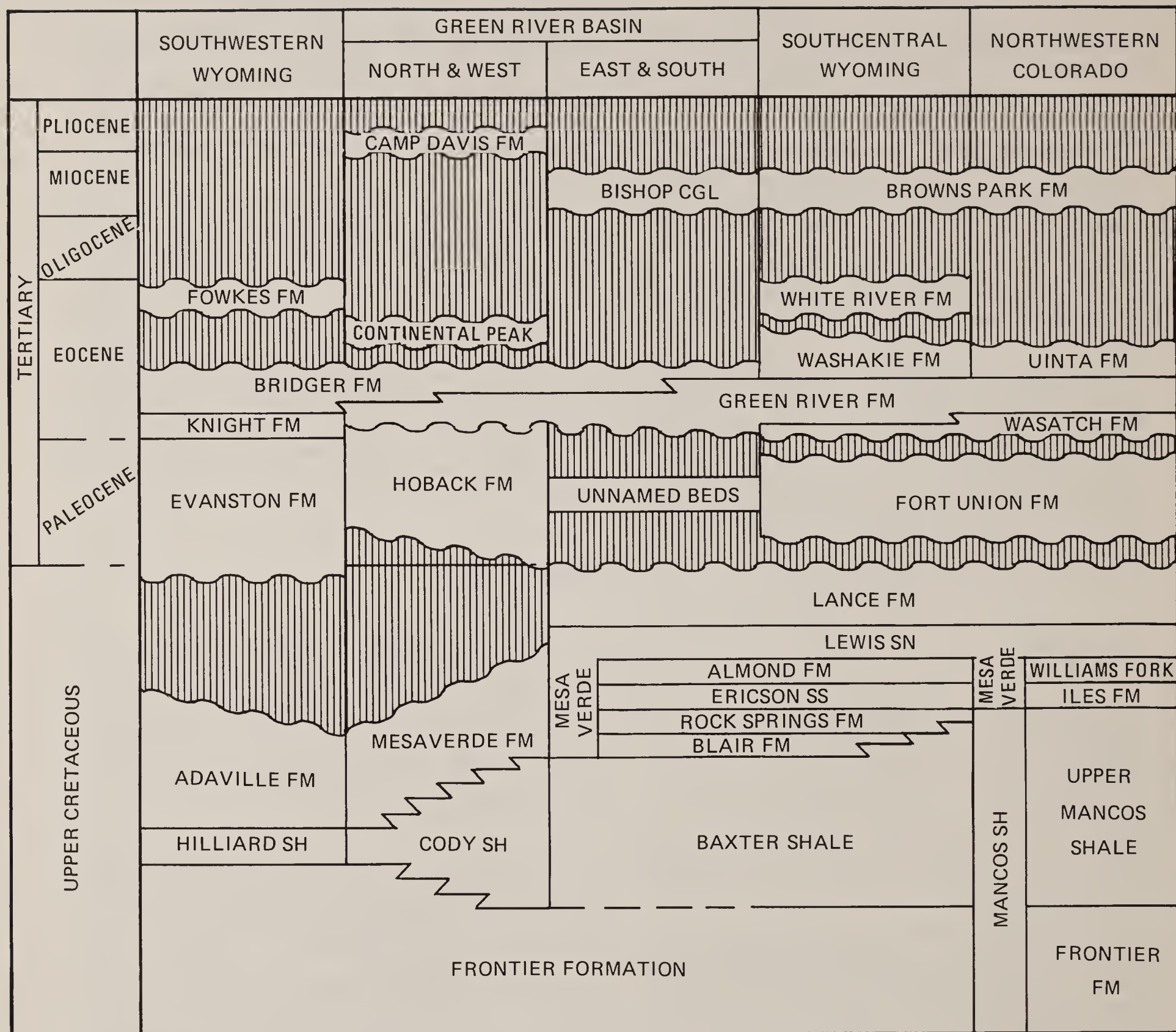


Figure 3-3. Stratigraphic Nomenclature and Correlation Chart for Green River-Hams Fork Coal EIS Region

AFFECTED ENVIRONMENT

However, there have been at least 10 seismic events recorded in Carbon and Sweetwater counties since 1955, with intensities of 3.0 to 6.0 on the modified Mercalli scale. Seismic activity occurs in two areas: the Rawlins uplift and an area about 25 miles northeast of Savery, Wyoming. Epicenters are illustrated in the Southcentral Wyoming Coal EIS (USDI BLM 1978b).

Landslide deposits have been inferred to be present and mapped within four proposed lease tracts: Middle Creek, Fish Creek, and Little Middle Creek in Colorado and Atlantic Rim in Wyoming.

Mineral Resources

Coal

Of the coal tracts delineated in Colorado, 10 are in the Yampa, 1 in the Danforth Hills, and 1 in the Lower White River coal fields. The coal beds of economic interest occur in the Iles and Williams Fork formations of Cretaceous age and the Fort Union Formation of Paleocene age.

Coal-bearing rocks of the Yampa coal field are the Iles and Williams Fork formations in the Williams Fork Mountains along the southern and southeastern margin of the Sand Wash Basin. Northward into the basin, the coal occurs in the Fort Union Formation. The coals are, for the most part, high-volatile C bituminous in rank (Murray 1981) but range from subbituminous to anthracite. Coals associated with Tertiary igneous intrusives are locally metamorphosed and upgraded to anthracite in the eastern portion of the field.

The Colorado portion of the Green River coal field has produced more than 114 million tons of coal from about 200 mines (Murray 1981). About 1 billion tons of coal are estimated to be potentially surface mineable (Speltz 1976), with over 60 billion tons within a depth of 3,000 feet.

The Danforth Hills field contains coal in the Iles and Williams Fork formations that ranges in grade from high-volatile C bituminous to anthracite. In-place coal resources have been estimated to originally have been 10.5 billion tons within 3,000 feet of the surface (Hornbaker and others 1976).

The Lower White River field located in northern Rio Blanco and southern Moffat counties has been estimated to have 11.8 billion tons of coal. The coal is within the Iles and Williams Fork formations and is principally high-volatile C bituminous.

Coal resources in the Wyoming portion of the coal region occur in the Green River coal field, Hanna coal field, and the Hams Fork coal field.

Coal-bearing strata of the Wyoming tracts are the Mesaverde Group (Almond and Rock Springs formations), Adaville Formation, and Lance Formation of upper Cretaceous age, along with the Fort Union Formation of Paleocene age.

The Green River coal field includes the Green River Basin, Rock Springs uplift, Washakie Basin, and west flank of the Rawlins uplift. Of the eight tracts located in the Green River coal field, two are situated on the east flank of the Washakie Basin; one on the west flank of the Rawlins uplift; and five on the northeast, south, and west flanks of the Rock Springs uplift. Coal-bearing units are the Mesa Verde Group, Lance Formation, and Fort Union Formation.

Mesaverde coals of the Green River coal field range from subbituminous to high-volatile C bituminous in rank, with most coals classified as subbituminous B. The coals have not been extensively mined but average up to 12 feet thick. Very little is known about the total in-place coal resources of the Green River coal field because the thick and laterally extensive cover of Tertiary sedimentary rocks has precluded exploration. However, 17 billion tons are estimated to have been originally present, with about 380 million tons mineable by surface methods. Lance and Fort Union coals are generally subbituminous B in rank and from 5 to over 30 feet thick on the east flank of the Rock Springs uplift.

Two coal lease tracts occur in the Hanna coal field, which has been estimated to contain about 313 million tons. Coal resources proposed for leasing occur within the Almond Formation and range from subbituminous C to high-volatile C bituminous.

The Hams Fork coal field contains two coal tracts with mineable coal in the Adaville Formation. The region is estimated to have originally contained about 4 billion tons of coal resources, with about 1 billion tons mineable by surface methods. The coal is classified as subbituminous B.

Oil and Gas

Coal development occurring concurrently with oil and gas development could create problems, but these would not result in significant impacts. Presently, the Bureau allows coal leases and oil and gas leases to be issued concurrently, with any problems being resolved at the lease development stage by the lessees in cooperation with the Bureau.

Oil and gas leases occur throughout the EIS region. Oil and gas fields are illustrated in Map Foldout Number 1 in Appendix B of the Final Environmental Statement of Northwest Colorado Coal

AFFECTED ENVIRONMENT

(USD) BLM, 1976) and the Oil and Gas Production Map of the Rocky Mountain Region (Terra Graphics, 1976). Stanborn (1981) notes that production occurs in every system from Pennsylvania through Tertiary, primarily from structural and stratigraphic traps along anticlines.

All of the proposed coal lease tracts contain oil and gas leases. The Point of Rocks, Pio, and Indian Springs tracts overlay known geologic structures and offer a good potential for oil and gas production.

Northeast Cow Creek Tract is within a known geologic structure and currently has three producing oil and gas wells within its boundaries. The leasing of this tract under the Maximum alternative and continued production of oil and gas would have to be worked out by the lease holders.

Future oil and gas exploration and production in the coal region is expected to be in new fields and pools in strata that are now producing. Since most of the easily identified structures have been explored, future production will probably be from stratigraphic traps and deep structures located by geophysical methods.

Other Minerals

Uranium has been produced from the Browns Park Formation near Lay and Maybell west of Craig, Colorado. Uranium production in the Maybell, Colorado, area was about 1.7 million tons of ore from the Browns Park Formation. The Maybell district has not produced since 1980. Southcentral Wyoming has produced 169,000 tons of ore from the Baggs-Poison Basin area (528,876 pounds of uranium oxide) and the Ketchum Buttes area (528,760 pounds of uranium oxide). Uranium has not been produced in southcentral Wyoming since 1967 (USDI BLM 1978a).

Exploration during the past 10 years has failed to locate economically mineable deposits in the Sand Wash Basin. Mining claims for uranium are present throughout the region and are generally staked over Fort Union (Paleocene), Wasatch (Eocene), and Browns Park (Miocene) formations. There is very little interest at present in uranium exploration and production, given a sharp drop in demand. Renewed interest will probably occur as stockpiles are depleted during the next decade.

Sand and gravel deposits are located along many streams and as pediment gravels in the coal region. Quality and quantity are not known due to the large size of the region. Supplies seem adequate to supply future needs, but sources close to population centers may become exhausted as these areas

grow. This would result in exploitation of deposits at greater distances from current areas of use.

Extensive deposits of scoria occur locally along the burn line of coal outcrops. It is used for road beds and as surfacing material where it is more available than sand and gravel. Many deposits have probably not been identified and reserves are unknown (USDI BLM 1978b).

Gold is present as placer deposits in the Wasatch Formation in the Great Divide area of the Sand Wash Basin. Exploration and development operations are currently being conducted by several companies.

Bituminous sandstone and conglomerate occur in various locations throughout the coal region. One notable location is at the contact between the Fort Union and Wasatch Formations in the China Butte-Red Rim area of Wyoming.

Sodium salts (Trona and associated minerals) are produced in the Green River Basin from Eocene lake deposits. Zeolites have been identified to occur in large tonnages in the Sand Wash Basin (Roehler 1973) and Washakie Basin. Clinoptilolite, a zeolite mineral, has been reported in the Browns Park Formation in the Lay area.

SOILS

Soils data for the region were summarized from the site specific analysis reports (SSAs) compiled for each tract. This summary is general; it cannot be used for detailed interpretive purposes.

The soils within the region are extremely variable, depending upon parent material, topography, climate, and vegetation. They are primarily formed from the weathering of sedimentary and some igneous geologic material. The sedimentary parent material consists mostly of sandstones and shales. The weathering of this material produces residual (in place), alluvial (stream deposited), and aeolian (wind deposited) soils.

Parent material and topographic positions are the primary factors differentiating the major soils of the region (USDI 1976). These soils have been combined for analysis and evaluation into the four groups discussed below. There is no discussion of prime or unique farmlands because these do not occur on any of the proposed lease tracts.

Stream Terraces and Floodplains: This group consists of deep, well-drained to poorly drained loamy and sandy loam soils. They are found on nearly level to gently sloping stream terraces and

AFFECTED ENVIRONMENT

floodplains of intermittent drainageways. They were formed in mixed alluvium derived from sedimentary rock. They have a slight to moderate erosion hazard, and, in some areas, a moderate to strong saline and alkaline condition.

Most of these soils occur in areas receiving 7 to 15 inches of annual precipitation. Vegetation produced on these soils is used for agricultural and livestock production, with some wildlife use also occurring. The reclamation problems associated with these soils would be high salinity and alkalinity conditions and sandy textures.

Uplands, High Terraces, and Alluvial Fans: This group consists of shallow, moderately deep, and deep, well-drained loamy and sandy loam soils located on sloping to rolling hills, convex ridges, and fans. These soils were formed in mixed materials and weathered from sedimentary (sandstones and shales) and metamorphic rocks.

The deep soils present few problems. However, the shallow and moderately deep soils are located on the steeper slopes, have low productivity, are sparsely vegetated, and are subject to a moderate to high erosion hazard. Vegetation produced on these soils is used for livestock grazing and wildlife habitat.

Most of the soils in this group occur within a zone of 7 to 15 inches of average annual precipitation. The reclamation problems associated with the soils in this group are a high percentage (greater than 35 percent) of rock fragments greater than 3 inches in diameter, clayey textures, and shallow soils.

Shallow, Steep Sloping, and Rock Outcrops: This group consists of predominantly shallow to moderately deep, well-drained, coarse textured soils. They are located on moderately steep to very steep sideslopes and escarpments bordering intermittent drainageways and stream courses. These soils are sparsely vegetated and subject to high runoff and high erosion hazard. They support vegetation used by wildlife and livestock.

This group occurs in zones of 7 to 22 inches of average annual precipitation. The reclamation problems associated with these soils are steep slopes, rock outcrops, and shallow soils.

Sideslopes and Mountain Foothills: This group consists of deep to moderately deep, well-drained, slightly acid to moderately alkaline sandy loam to loamy soils. These soils are located on sloping to steep sloping sideslopes and mountain foothills. They are subject to slight to moderate erosion hazard. Vegetation produced by these soils is used for livestock grazing and wildlife habitat and occurs in zones of 12 to 22 inches of precipitation. Included in this group are soils that are deep, well-

drained, and loamy-skeletal and have a high percentage of coarse fragments and rock. They are located on narrow flood plains with intermittent drainages bordered by steep mountain sideslopes.

Reclamation problems associated with these soils include steep slopes on the mountain foothills and a high percentage of coarse fragments on the mountain floodplains.

Erosion

Soil erosion from water and wind action in the region averages 3 to 5 tons per acre per year. Many steep, sparsely vegetated slopes occurring throughout the region have higher rates of erosion from water. A high rate of wind erosion occurs over areas of low precipitation (7 to 15 inches) and with sandy textured soils.

WATER RESOURCES

Introduction

The Green River-Hams Fork Coal Region includes the upper parts of seven river basins and a portion of the Great Divide Basin, which has no drainage to either ocean. The North Platte River drains areas east of the Continental Divide to the Mississippi River, while the Colorado, Green, Little Snake, White, and Yampa rivers drain west of the divide. The Bear River flows to Great Salt Lake and a number of small closed depressions are contained in the Great Divide Basin, the largest of which is Separation Lake. The four major river basins of concern in this analysis are the North Platte, Green, Yampa, and White rivers.

Sizes of the watersheds included in this analysis were determined by the most suitable U.S. Geological Survey (USGS) gaging station records that encompassed all potential lease tracts. The hydrologic units chosen are the smallest drainage basins with conclusive data available and are large enough to indicate regional impacts, if any.

The Green River basin referred to in this analysis covers an area of 9,742 square miles upstream from Green River, Wyoming. The North Platte basin encompasses 14,888 square miles above Orin, Wyoming, including North Park in Colorado.

The Yampa River basin covers an area of 3,410 square miles upstream from Maybell, Colorado. The White River basin encompasses an area of 3,680

AFFECTED ENVIRONMENT

square miles upstream from the Utah/Colorado state line.

Groundwater availability and chemical quality is greatly influenced by geology. In general, the older consolidated rocks yield water slowly (and of poorer quality) to wells and springs, whereas sand and gravel deposits in the younger unconsolidated deposits yield better quality water readily. The geologic structure generally controls the movement of water through the various structural basins. The groundwater characteristics are described separately for Colorado and Wyoming, even though many of the aquifers are found in both states. A discussion of groundwater phenomena that applies to the entire region precedes the state descriptions.

Further information on the basin-wide water resources in the Green River-Hams Fork area can be found in the Southcentral Wyoming Coal Environmental Statement, Southwestern Wyoming Coal Environmental Statement, and the Northwestern Colorado Coal Regional Environmental Statement (BLM 1979c and 1976).

Surface Water

Surface water in the EIS area serves a number of critical needs. Surface water is used for irrigation of cropland, for livestock and wildlife, and to meet demands by local industrial users and municipal governments.

Surface runoff from the coal areas ranges widely in quantity from one part of the region to another. Annual runoff is highest in the mountainous areas of the eastern part of the Yampa River subbasin, where annual precipitation exceeds 40 inches, and is lowest in the western part of the Yampa River subbasin and lower North Platte River basin, where annual precipitation is less than 12 inches.

Drainage Channels and Salt Loading

There are two distinct types of streams in the Green River-Hams Fork Coal Region: (1) streams that originate in and drain mountain areas and (2) streams which flow from coal area drainages. These are portrayed in the hydrology map in the map packet. Tables 3-7 and 3-8 show that the annual runoff from coal area drainages averages only about 35 acre feet per square mile, whereas annual runoff from mountain areas averages more than 18 times that amount. Taken together, these two types of streams represent the major coal region basins. None of the proposed tracts is found in a mountain watershed.

Stream and channel characteristics in the lower elevations of the drainages are meandering, causing much bank caving and sloughing and resulting in steep banks. This adds considerably to the sediment loads in the streams during periods of high runoff. These occurrences are during rapid snowmelt and early spring runoff, as well as during occasional intense summer thunderstorms.

The streams that drain coal areas have measured peak discharges per unit area that are unusually small for watersheds containing less than 35 square miles. Small watersheds characteristically have much higher unit peak discharges, often exceeding 100 acre-feet per square mile. This inconsistency is attributed largely to the short period of record of 1 to 7 years for the coal area drainages. Apparently, no large runoff events have occurred during this period. It is possible that the sandy soils in most coal areas tend to absorb most rainfall, thereby minimizing runoff. Table 3-7 shows that the annual runoff from the coal drainages averages about 0.92 inches.

Coal tract areas contain a number of reservoirs (listed in table 4-2 in Chapter 4)). Most of these are under 3 acre-feet in capacity and are used for livestock watering.

The runoff that nourishes the streams draining coal areas commonly contains more than 1,000 mg/l dissolved solids in the spring and fall, about two to four times the corresponding values for mountain area drainages. As tables 3-7 and 3-8 show, most of the water leaving the overall coal region originates in the mountain areas, while most of the dissolved solids (salt loading) are from areas surrounding the coal tracts.

Of the coal area drainages, there are two streams that are of critical concern: Fish Creek and Trout Creek, both of which are in the Yampa River basin. Fish Creek and Trout Creek are discussed in detail in the Kaman Tempo Report, 1982, titled "Cumulative Hydrologic Assessment: Effects of Coal Mining on the Yampa River Basin, Moffat and Routt Counties, Colorado." Both of the creeks have small watersheds which have high concentrations of active coal mining, with expansion being planned. There is a concern that elevated total dissolved solids from existing mines may increase to the point that water may become unusable for agricultural and aquatic wildlife.

Table 3-9 shows selected water resources data from the four major rivers that drain the region: the Green, North Platte, White, and Yampa. These gages were chosen to represent the area because they have good records over long periods of time. (Although the gage on the White River only has 8 years of recorded data, it correlates well with those

TABLE 3-7

HYDROLOGIC DATA* FOR SOME STREAMS DRAINING COAL AREAS

Basin	Station	Station † Number	Years of Record	Drainage Area (Sq mi)	Average Annual Runoff			Peak Discharge		Minimum Discharge (cfs)	Range in 1980	
					(ac-ft/ (ac-ft)	sq mi)	(Inches)	(cfs)	sq mi)		Dissolved Solid (mg/l) Concentration	pH (Units)
Green	Vermillion Cr. at Ink Sprs. Ranch	09235450	5	816	2,340	2.9	.05	1,160	1.4	0	875 - 1200	8.3 - 8.6
Gt Divide	Separation Creek near Rines	09216527	5	55.3	1,520	27.5	.52	141	2.5	0	319 - 795	7.8 - 8.6
Green	Salt Wells Creek near S. Baxter	09216565	4	34.7	1,117	32.2	.60	347	10.0	0	510 - 1325	8.1 - 8.8
Green	Dry Canyon Creek near S. Baxter	09216578	4	3.69	17	4.6	.09	23	6.2	0	---	---
Green	Kill Pecker Creek at Rock Springs	09216810	5	--	--	--	--	--	--	--	1210 - 6680	7.5 - 8.9
Green	Ryckman Creek near Glencoe	09222200	1	53.4	--	--	--	29	0.5	.84	---	8.5 - 8.7
Green	Little Muddy Creek near Glencoe	09222300	4	416	14,790	35.6	.67	520	1.3	.72	401 - 2480	7.7 - 8.7
Green	Muddy Creek near Hampton	09222400	5	963	26,950	28.0	.52	754	0.8	0	327 - 2630	7.8 - 8.5
N Platte	Big Ditch near Coyote Springs	06630300	6	110	782	7.1	.13	396	3.6	0	708 - 1910	8.2 - 8.6
N Platte	North Ditch near Coyote Springs	06630330	5	22.6	434	19.2	.36	89	3.9	0	179 - 290	7.7 - 9.1
Yampa	Fish Creek near Milner	09244100	17	34.5	9,130	264.6	4.96	342	9.9	.40	161 - 483	8.0 - 8.4
Yampa	Middle Creek near Oak Creek	09243700	6	23.5	2,200	93.6	1.76	172	7.3	0	411 - 552	7.6 - 8.4
Yampa	Foldel Creek near Oak Creek	09243800	6	8.61	536	62.3	1.17	55	6.4	0	663 - 890	7.1 - 8.1
Yampa	Foldel Creek at Mouth	09243900	6	17.5	1,350	77.1	1.45	90	5.1	0	749 - 1500	7.6 - 8.2
Yampa	Wilson Creek near Axial	09250600	6	20.1	1,590	79.1	1.48	94	4.7	.12	502 - 1270	7.7 - 8.3
Yampa	Taylor Creek near Axial	09250510	7	7.22	94	13.0	.24	18	2.5	0	512 - 1270	8.0 - 8.6
Yampa	Trout Creek near Oak Creek	--	--	--	--	--	--	--	--	--	65 - 164	7.9 - 8.3
Yampa	Jubb Creek near Axial	09250610	6	7.53	77	10.2	.19	5.6	0.7	0	947 - 1510	7.8 - 8.6
Yampa	Morgan Gulch near Axial	09250700	1	25.6	736	28.8	.54	9.2	0.4	.08	992 - 1200	8.2 - 8.4
White	Coal Creek near Meeker	09304480	4	--	--	--	--	--	--	--	353 - 1700	7.5 - 8.2
White	Curtis Creek near Meeker	09304550	4	--	--	--	--	--	--	--	2160 - 5580	7.7 - 8.3
AVERAGE FOR STATIONS						34.7	.92		3.9			

* From USDI Geological Survey 1980^a, 1980^b

† U.S. Geological Survey (USGS) Station number. Locations of stations are shown on the water resources map.

TABLE 3-8

HYDROLOGIC DATA* FOR SOME STREAMS DRAINING MOUNTAIN AREAS

Basin	Station	Station † Number	Years of Record	Drainage Area (Sq mi)	Average Annual Runoff			Peak Discharge		Minimum Discharge (cfs)	Range In 1980	
					(ac-ft/ (ac-ft)	sq mi)	(Inches)	(cfs)	(cfs/ sq mi)		Dissolved Solid (mg/l) Concentration	pH (Units)
N Platte	Grizzly Creek near Hebron	06611300	4	223	40,970	183.7	3.4	1,130	5.1	0.47	152 - 198	6.9 - 7.8
N Platte	Little Grizzly Creek above Coalmont	06611800	3	35.4	20,950	591.8	11.1	394	11.1	1.2	60 - 132	7.1 - 7.5
N Platte	North Brush Creek near Saratoga	06622700	20	37.4	36,080	964.7	18.1	1,120	29.9	4.7	---	---
N Platte	Encampment River at mouth	06625000	40	265	174,600	658.9	12.4	4,510	17.0	5.2	56 - 350	7.2 - 8.2
Green	New Fork River near Big Piney	09205000	26	1,230	523,100	425.3	8.0	9,170	7.5	90.	51 - 142	7.4 - 8.5
Green	Little Sandy Creek above Eden	09214500	26	134	13,910	103.8	1.9	1,450	10.8	0	70 - 427	7.4 - 8.4
Green	Hams Fork below Pole Creek	09223000	28	128	73,170	571.6	10.7	1,520	11.9	0.1	---	---
Yampa	Yampa River at Steamboat Springs	09239500	74	604	335,400	555.3	10.4	6,820	11.3	4.0	---	---
Yampa	Elk River at Clark	09241000	63	206	241,300	1,171.4	22.0	4,470	21.7	22.	---	---
Yampa	Elkhead River near Elkhead	09245000	28	64.2	38,830	604.8	11.3	1,870	29.1	0	---	---
Yampa	S. Fork Williams Fork River near Pagoda	09249200	14	46.7	30,650	656.3	12.3	910	19.5	0	109 - 327	7.1 - 8.6
Yampa	Little Snake River near Slater	09253000	36	285	163,000	571.9	10.7	4,180	14.7	8.6	50 - 160	7.2 - 8.4
White	White River above Coal Creek	09304200	20	648	388,300	599.2	11.2	4,900	7.6	6.5	118 - 302	7.5 - 8.6
White	Lost Creek near Buford	09302450	17	21.5	15,360	714.4	13.4	944	43.9	0.3	---	---
White	South Fork White River near Budge's	09303300	6	52.3	69,550	1,329.8	24.9	1,580	30.2	21.	---	---
AVERAGE VALUES						646.9	12.1		18.1			

* From USDI Geological Survey 1980^a, 1980^b

† U.S. Geological Survey (USGS) Station number. Locations of stations are shown on the water resources map.

TABLE 3-9

MAJOR COAL REGION RIVER BASINS

Station	Station Number	Drainage Area (Sq. MI)	Ac.-ft./yr.	Ac.-ft./Sq.mi.	Period of Record (Yrs)	Suspended Sediment (ton/yr.)	Specific Conductance (Micromhos)	TDS** Mg/l	Suspended Sediment Yield (Tons/Ac./Yr.)
Green River near Green River, Wyoming	09217000	9,742*	969,800	99.5	28	681,239	546	355	0.11
North Platte River at Orin, Wyoming	06652000	14,888	1,070,000	76.4	24	259,927	715	464	0.03
White River near CO/UT state line	09306395	3,680	526,500	143.1	8	986,478	772	502	0.42
Yampa River near Maybell, Colorado	09251000	3,410	1,280,000	375.4	64	651,041	639	416	0.30

SOURCE: USGS Water Resources Data: Wyoming 1979, Colorado 1980.

* Actual drainage area 14,000 mi² of which 4,260 mi², is in Great Divide Basin and noncontributing to this gauge.

** TDS: total dissolved solids determined to be 0.65 of specific conductance.

AFFECTED ENVIRONMENT

at other downstream points.) The four major coal region rivers contrast markedly with the streams in mountain areas (table 3-8).

The water resources data found on table 3-9 on streams that drain the major coal region basins are taken from established gages that have daily records. They therefore represent an average of all the parameters of the streams that drain both mountain and coal areas. The large systems do have a buffering effect on salt loading from the coal area streams.

Sediment Yield

Premining sediment yields were determined by dividing a river basin acreage by the tons per year of suspended sediment at the gages listed in table 3-9. The result, suspended sediment yield in tons per acre per year, was then applied to the lease tracts that lie in the river basins. Yields ranged from 0.03 to 0.42 tons per acre per year. This figure is lower than most figures used for sediment yield for two reasons: (1) the results of erosion, overland transport, and sediment movement are deposited before reaching the gages; and (2) bed load transport, which could double the sediment yields shown above, is ignored.

Water Use

Present and projected consumptive annual use of water and concentrations of dissolved solids in the North Platte, Green, White, and Yampa River watersheds for the time frames addressed in this analysis are presented in tables 4-3 through 4-6 in the next chapter. Conditions in both watersheds were approximated by working backwards from known consumptive uses of water and changes in salt load as a result of human activities to estimate undepleted water supply, use of water by riparian vegetation, and natural sources of salt. As this approach is subject to considerable error, the conditions shown should be regarded only as indicative of inferred pristine conditions.

Urban Pollution

The Green River-Hams Fork region is sparsely populated. The population was about 121,609 in 1980. The average density was about 3.5 persons per square mile, compared with a national average of 64. The major towns in the region currently have adequate wastewater treatment plants or plants under construction.

Flood Plains and Alluvial Valley Floors

There are 45 flood plains, 1 alluvial valley floor, and 14 alluvial stream deposits on the proposed lease tracts. See the Glossary for definitions of flood plains and alluvial valley floors.

Groundwater

The proposed lease tracts in both Wyoming and Colorado typically occur in areas where structural deformation and differential erosion have exposed coal-bearing formations at or near the surface. The result is generally inclined rock layers on the sides of anticlinal folds that have been eroded to form long perpendicular valleys separated by broad slopes. The valleys are cut in the softer rocks such as shale and coal, whereas the dipslopes are underlain by the more resistant sandstone beds.

Groundwater Flow

Groundwater recharge to these upturned beds occurs primarily on the high interstream areas during infrequent periods of excessive precipitation and saturated soil-moisture conditions. Movement is initially downward to the first relatively impermeable shale layer, which greatly retards any further downward movement and deflects the "perched" water downdip or laterally towards any incised valleys that break the continuity of the beds.

Characteristically steep hydraulic gradients in the downdip direction range from 50 to 500 feet per mile. However, most groundwater movement in the coal areas is not downdip but occurs along the direction of strike towards the nearest valley in which the "perching" layer is exposed in the valley side slopes. This sideways movement meets less resistance because of transmissivity and fractures. This discharge commonly is evidenced by elongate patches of giant wild rye or verdant bands of other plant types that parallel rock outcrops. The additional moisture provided by groundwater discharge in these areas stimulates plant growth but generally is not sufficient to saturate the soil veneer and appear at the surface as springs. The absence of any springs on any of the tracts in the North Platte watershed in Wyoming and the paucity of springs on or adjacent to the western tracts in Colorado attest to the low rate of groundwater discharge from these coal areas.

AFFECTED ENVIRONMENT

Aquifers and Water Quality

The top of the zone of saturation in the coal areas is typically graded to the level of the nearest perennial stream or to the level of perennial underflow in alluvium underlying intermittent or ephemeral streams. Above this level, perched groundwater generally can be found within 200 feet of the surface. These perched zones commonly overlie unsaturated rocks so that test holes often show vertical drainage downward from shallow aquifers into underlying unsaturated coal and sandstone beds. Wells tapping perched aquifers seldom yield more than 10 gallons per minute (gal/min).

Perching is most prevalent in those tracts in Colorado where annual precipitation exceeds 15 inches but is less important in the Wyoming tracts, where annual precipitation is less than 10 inches. Dissolved solids concentrations in water obtained from perched aquifers in Colorado generally range from 750 to 1,500 milligrams per liter (mg/l). Values in Wyoming, where the lower annual precipitation results in less flushing of perched aquifers, range from 2,000 to 6,500 mg/l.

Below the top of the zone of saturation, groundwater typically occurs under confined conditions. Wells drilled more than 200 feet deep on the valley floors in the Yampa River subbasin commonly flow at the land surface, although yields seldom exceed 10 gal/min. The water generally contains 500 to 1,000 mg/l dissolved solids and is generally suitable for most domestic and ranch uses. In contrast, no flowing wells occur on or adjacent to any of the lease tracts in the North Platte River basin in Wyoming, undoubtedly reflecting the dryer climate and lesser recharge in that part of the region. Most bed-rock wells yield less than 10 gal/min of water containing 2,000 to 4,000 mg/l dissolved solids that is suitable for use by livestock and wildlife but unsuitable for domestic use.

The importance of coal beds as aquifers in the vicinity of the lease tracts in both Wyoming and Colorado is uncertain, but available data indicate that most wells in the coal areas obtain water from sandstone beds and not from coal. The reason is tentatively attributed more to the preponderance of sandstone in rocks underlying these areas rather than to any quantity or quality of water considerations, although water obtained from coal beds sometimes has an unpleasant hydrogen sulfide odor. Coal beds may not be water bearing above the top of the saturated zone, but below that level, they must be regarded as potential aquifers.

Yampa and White River Basins

Groundwater may be found at varying depths throughout the area. Aquifers include sand and gravel in the alluvium (sediment deposits) of the Yampa River and its principal tributaries; sands, semiconsolidated sandstones, and conglomerates of the Browns Park Formation; sandstones of the Fort Union, Wasatch, Williams Fork, and Iles formations; and fractured and weathered shales in the Lance Formation and the Lewis and Mancos shales. Table 3-10 portrays formations in northwestern Colorado.

The quality of groundwater is variable and depends, in part, on rock type. Most of the waters are calcium and sodium bicarbonate types because of the abundance of granitic rock fragments rich in calcium and sodium and the presence of calcium carbonate as a cement in most of the sandstones and conglomerates. Calcium sulfate type waters are found where water in the aquifer has been in contact with gypsum, organic materials, or coals. Sodium bicarbonate and sodium sulfate type waters occur in aquifers where calcium bicarbonate and calcium sulfate type waters are in contact with clays or weathered shales. Calcium ions readily replace sodium ions from the clays and weathered shales.

A regional water table probably does not exist in the fractured shale aquifers of the Lewis and Mancos shales. Groundwater circulation is shallow and, in most places, extremely poor. Water that enters the aquifers in areas of recharge does not move laterally any appreciable distance before it is discharged at a spring or seep. Some groundwater is discharged from shale to alluvial aquifers but, because of the lack of a regional water table and the shallow circulation, the volume of discharge is relatively small.

In the northwestern part of the area, groundwater in the Browns Park, Wasatch, and Fort Union formations is virtually one groundwater system. Groundwater in these aquifers moves downward and to the west. Discharge is by underflow out of the study area. With the exception of Fortification and Elkhead creeks, no groundwater is discharged from these aquifers to streams. The confined aquifers are recharged in parts of the area where the Yampa River and its tributaries flow over the sandstones. Recharge to the confined aquifers also occurs by leakage from the Browns Park Formation in the southeastern part of the area. Discharge from the confined aquifers occurs principally to the west and northwest out of the area. Locally, discharge from the confined aquifers can occur in the eastern and southern parts of the area. In these areas, the Lewis Shale and the Williams Fork and Iles formations are faulted extensively, and perennial springs

TABLE 3-10

WATER BEARING FORMATIONS IN NORTHWESTERN COLORADO
YAMPA AND WHITE RIVER BASINS

System	Formation (major aquifers)	Thickness (ft)	Physical Character	Yields (gpm)	TDS (mg/l) Water Quality	Use	
Quaternary	Alluvial deposits (Yampa, Little Snake, Williams Fork Rivers)	20 - 40	Clay, sand, gravel, boulders, and glacial debris	up to 1000	80 - 3,000	Stockwater	
Tertiary	North Park	up to 1,500	Poorly sorted silt, clay, sand, and gravel. Contains lenses of sandstone and siltstone	400 - 700	135 - 150	Stockwater & Domestic	
	Browns Park	up to 1,800	Fine-grained grayish sandstone, gravel, cobbles, chert, fresh water limestone, and a conglomerate at base	up to 300	200 - 1,000	Stockwater & Domestic	
	Wasatch	300 - 5,000	Clay, shale, and lenses of sandstone, limestone, and conglomerate	up to 500	500 - 2,800	Stockwater & Domestic	
	Fort Union	1,400 \pm	Sandstone, fine to coarse-grained, carbonaceous shale, and coal	3 - 300	440 - 700		
30	Lance	1,050 - 1,500	Sandstone, very fine to fine grained, lenticular, clayey, calcareous	5 - 30		Stockwater	
Cretaceous	Lewis Shale	1,500 - 1,900	Shale, light-to-dark gray, carbonaceous beds of siltstone and v. fine grained sandstone	less than 5	270 - 4,200		
	Mesaverde Group	Williams Fork (Twentymile sandstone)	1,100 - 3,000	Sandstone, very fine to medium grained, calcareous, silty, interbedded dark shale lignite and coal	10 - 100	330 - 1,460	Domestic & Stockwater
		Hles (Trout Creek Sandstone, Tow Creek Sandstone)	1,450 - 1,550	Sandstone, very fine to medium grained, calcareous, silty, interbedded dark shale lignite and coal	10 - 100	330 - 1,460	Domestic & Stockwater
		Mancos Shale	4,500 - 5,000	Marine shale and interbedded siltstone and very fine to medium grained sandstone	less than 5	270 - 4,200	

AFFECTED ENVIRONMENT

flow in places where the faults extend to the land surface.

Groundwater use in the Yampa and White River basins is limited largely to livestock and domestic wells for ranchers. There are also a few water supply wells for oil drilling operations.

North Platte and Eastern and Central Green River Basins

As yet, human activities, such as alteration of the land surface and withdrawal of water, have not significantly changed the hydrologic conditions in most of the area. A balance between groundwater recharge and discharge in the area is indicated by the slight annual water-level fluctuations (less than 2 feet) observed in 12 wells. Recharge, the addition of water to the groundwater reservoirs, is mainly by seepage from precipitation and streams. Discharge, the release of water from groundwater reservoirs, is primarily by evaporation, seepage to streams and lakes, transpiration by plants, and pumpage from wells. Some groundwater moves away as underflow along streambeds and in aquifers that extend out of the area.

Groundwater occurs in the area under both water-table (unconfined) or artesian (confined) conditions. A number of unconfined aquifers are present in the area. They generally are permeable "blanket" type deposits of Quaternary or Tertiary age. Alluvial, wind-blown, lake, glacial, and gravel deposits fall into this category. For the most part, aquifers in the North Park and Browns Park formations and in the Bishop Conglomerate are also unconfined. Table 3-11 summarizes parameters for the North Platte and Green River basins.

Most of the formations of pre-Oligocene age in the area contain water under artesian pressure. The depth to the water surface in both water-table and artesian wells in the area is generally less than 200 feet, but the drilling depth to the artesian aquifers may be much greater.

Individual water-bearing units within the formations (see table 3-11) may differ greatly in thickness and extent, but they are probably interconnected sufficiently to permit indirect or partial hydrologic connection in varying degrees. The principal water-bearing units are composed of sandstone, which ranges from very fine to coarse grained.

It is not possible to define the character of individual sandstone aquifers with available information. Aquifers differ considerably in thickness, distribution, sorting, roundness, grain size, cementation, and the clay and silt content, reflecting the considerable variation in aquifer characteristics.

The predominant use of groundwater in the area is for stock watering. A relatively small number of wells and springs are used for municipal and domestic supplies, and a few wells provide small business supplies along U.S. Highway 30 (Interstate 80). Industrial use includes oil well and coal mining operations, highway construction, and railroad operations. Groundwater is not used for irrigation except on lawns and small gardens.

Flowing wells can be obtained in parts of the study area where the sandstones are overlain by impermeable shales and where recharge of the sandstones occurs at a higher altitude than the well sites. The yields of flowing wells decrease rapidly as pressure in the aquifer decreases.

VEGETATION

Introduction

For vegetation, the affected area consists of 11,481,740 acres in Wyoming and 2,801,445 acres in Colorado. The environments described are the areas delineated in the Green River-Hams Fork Round 1 Coal EIS, the Southwest Wyoming Coal Environmental Statement, and the Meeker and Rangely Planning Units. This area is identical to the region described in the Wildlife section. The region consists of 11 broad vegetation types. The dominant type in both Colorado and Wyoming is sagebrush. Table 3-12 displays the acreage and percent of each vegetation type.

The vegetation of this region is affected by soils, climate, aspect, elevation, topography, and past land use history. Moisture is most often the general limiting factor for the distribution of vegetation.

Vegetation Types

These type descriptions are summaries of the major plant communities within the region. Information regarding the vegetation of specific tracts can be found in the site specific analysis reports for Colorado and Wyoming.

Sagebrush

The sagebrush type is the dominant plant community in the EIS region, consisting of 6,974,060 acres in Wyoming and 1,185,584 acres in Colorado. This represents 57 percent of the total region.

TABLE 3-11

WATER BEARING FORMATIONS IN SOUTHWESTERN AND SOUTHCENTRAL WYOMING
NORTH PLATTE AND GREEN RIVER

System	Formation (major aquifers)	Thickness (ft)	Physical Character	Yields (gpm)	TDS (mg/l) Water Quality	Use	
Quaternary	Alluvial deposits (N. Platte, Little Snake, Green, Blacks Fork, Hams Fork)	0 - 50	Clay, silt, sand, and gravel, unconsolidated	up to 1,000	300 - 930	Stockwater	
Tertiary	North Park	0 - 800	White limestone, green and brown claystone and shale, rusty sandstone and lenticular conglomerate	up to 400	200 - 240	Municipal	
	Browns Park	0 - 1,200	Light gray sandstone interbedded with tuff, pumicite, limestone, and claystone	up to 300	200 - 1,000		
	Bishop Conglomerate	0 - 200	Contains well rounded boulders and cobbles of quartzite limestone and schist	40	560 - 600		
	Battle Springs Formation	Laney Shale Member of the Green River Formation	0 - 1,900	Marlstone, shale, oil shale, muddy sandstone, tuffaceous sandstone, algal limestone	up to 200	560 - 3,450	Stockwater
		Wasatch	1,000 - 4,000	Gray, green, and red mudstone and sandstone, gray sandstone, thin coal, and some oil shale	5 - 250	500 - 2,800	Stockwater & Domestic
	Ft. Union	700 - 2,700	Thick white sandstone, gray and brown siltstone, and shale and coal beds	3 - 300	800 - 5,000	Stockwater	
	Lance	0 - 4,500	Carbonaceous shale, tan sandstone and siltstone, coal beds	5 - 30		Stockwater	
	Lewis Shale	0 - 2,700	Shale, dark gray with many gray sandstone beds	4	1,640		
	Adaville (Lazear sandstone)	4,000 \pm	Yellow, black, and gray carbonaceous shale interbedded with brown and buff sandstone with many seams of coal underlined with basal white resistant sandstone lentil		760 - 2,000	Stockwater	
	Hilliard Shale	2,940 - 6,800	Drab to gray shale with few beds of sandstone				
Cretaceous	Mesaverde Group	Almond	400 - 1,000	Gray sandstone, dark gray shale, and many coal beds			
		(Pine Ridge Sandstone)	180	Brown to white sandstone and gray shale and coal beds			
		(Allen Ridge)	1,000	Brown to white sandstone and gray shale and coal beds			
		(Haystack Mountain)	2,800	Brown to white sandstone and gray to black shale			
		Ericson Sandstone	400 - 700	Sandstone, fine-grained to conglomeratic, rusty sandstone and shale	10 - 200	300 - 1,200	
		Rock Springs	300 - 2,800	Sandstone, fine to medium grained interbedded with carbonaceous shale and coal	20 - 800	600 - 8,000	
		Blair	4,000	Shale, sandy, interbedded with siltstone and fine to medium grained sandstone	less than 60	greater than 3,000	
		Frontier	190 - 900	Gray sandstones interbedded with dark gray shale, some thin bentonite beds	up to 50	720 -10,000+	Oil well Supply

TABLE 3-12
VEGETATION TYPES

Vegetation Types	Wyoming		Colorado		Total Environment	
	Acres	%	Acres	%	Acres	%
Grasslands	561,780	92	48,412	8	610,192	4
Sagebrush	6,974,060	85	1,185,584	15	8,159,644	57
Mountain Shrub	207,660	28	521,889	72	729,549	5
Pinyon/Juniper	455,100	57	350,143	43	805,243	6
Saltbush	871,400	91	88,312	9	959,712	7
Greasewood	939,250	96	37,231	4	976,481	7
Aspen	197,660	50	197,347	50	395,007	3
Riparian	158,320	77	45,986	23	204,306	1
Cropland	175,400	52	163,723	48	339,123	2
Rock Outcrop/Ridges	155,950	100	0	0	155,950	1
Conifers	<u>785,160</u>	82	<u>162,818</u>	18	<u>947,978</u>	<u>7</u>
TOTALS	11,481,740		2,801,445		14,283,185	100

NOTE: Percentage figures for Colorado and Wyoming show the relative amount of each vegetation type in each state.

AFFECTED ENVIRONMENT

Wyoming big sagebrush (*Artemisia tridentata wyomingensis*) and basin big sagebrush (*Artemisia tridentata tridentata*) are the most common species. Other sagebrush species that also occur as part of this type are black sagebrush (*Artemisia nova*), silver sagebrush (*Artemisia cana*), bud sagebrush (*Artemisia spinescens*), and fringed sagebrush (*Artemisia frigida*). Other shrubs that occur occasionally in a mixed association with the sagebrush are Douglas rabbitbrush (*Chrysothamnus douglasii*), bitterbrush (*Purshia tridentata*), greasewood, serviceberry, snowberry (*Symphoricarpos* sp.), and saltbush, depending on the site and its ecological condition. Densities, plant associations, and dominance vary within the region.

The common associated grass species of the sagebrush type are Indian ricegrass (*Oryzopsis hymenoides*), western wheatgrass (*Agropyron smithii*), needle and thread (*Stipa comata*), bluebunch wheatgrass (*Agropyron spicatum*), junegrass (*Koeleria* sp.), bottlebrush squirreltail (*Sitanion hystrix*), Columbia needlegrass (*Stipa columbiana*), and bluegrasses (*Poa* sp.). Other plant species associated with this type are sedges (*Carex* sp.), yarrow (*Achillea* sp.), arrowleaf balsamroot (*Balsamorhiza* sp.), Indian paintbrush (*Castilleja* sp.), beardtongue (*Penstemon* sp.), prickly pear cactus (*Opuntia polyacantha*), and lupine (*Lupinus* sp.). Cheatgrass (*Bromus tectorum*) is quick to invade at the first sign of deterioration or overuse.

The sagebrush type can be found adjacent to all other types throughout the region and in various ecological conditions, depending on the extent of historical grazing use. The sagebrush plant community generally consists of a mixture of low growing shrubs dominated by big sagebrush, with a variable understory of perennial grasses and herbaceous broad-leaved species. The presence and variety of annuals fluctuates from year to year, depending on spring temperatures and precipitation. The shrub layer varies from very open to completely closed stands. Several of the combinations and different associations of plant species within the sagebrush type support a variety of wildlife.

Riparian

The riparian type is defined for the purpose of this document as those areas of deciduous cottonwoods, willows, and water birches occurring along main drainages or rivers, marshlands, lakes, and open aquatic wetlands. In many cases, some so-called riparian areas are too small to be differentially classified from the surrounding vegetation type. The quantity of live water and plant associations and densities of the riparian type varies throughout the EIS region. The trees and shrubs generally in-

cluded as components of this type are narrowleaf cottonwood (*Populus angustifolia*), box elder (*Acer negundo*), various willows (*Salix* sp.), water birch (*Betula occidentalis*), dogwood (*Cornus* sp.), hawthorn (*Crataegus* sp.), and wild rose (*Rosa* sp.). Associated understory species may consist of bluegrass, bromes, rushes (*Juncus* sp.), sedges (*Carex* sp.), wheatgrasses, and wildrye (*Elymus* sp.). In poorly drained marshy areas, cattails (*Typha latifolia*) may be present. The riparian community supports a variety of animal life, particularly waterfowl and nesting birds.

Grasslands

The grasslands of the region are in poor to fair range condition and in a state of deterioration. Some areas that were at one time natural grasslands have converted to sagebrush as a result of historic overgrazing and wildfire control.

The grassland vegetation type ranges from short grass communities and upland meadows to stream or spring associated grass communities maintained by water tables that are within root depth during most of the growing season. They occur as small native grass meadows, as isolated patches on windswept ridges, and on gentle, rolling hills. Nonirrigated grassland areas created by vegetation manipulation, seeding, and wildfires are also included in this type for the purposes of this document. (Irrigated cropland is discussed later in this section as a separate type.)

Grasslands of the affected region consist primarily of perennial bunch grasses intermixed with half shrubs, broad-leaved species, occasional shrubs, and annual grasses.

The dominant grass species of the eastern part of the region are needle and thread (*Stipa comata*), Columbia needlegrass (*Stipa columbiana*), green needlegrass (*Stipa viridula*), various bromes (*Bromus* sp.), and timothy (*Phleum pratense*). The major species of the central and western areas are western wheatgrass (*Agropyron smithii*), bluebunch wheatgrass (*Agropyron spicatum*), needle and thread, prairie junegrass (*Koeleria cristata*), Indian ricegrass (*Oryzopsis hymenoides*), and bluegrasses (*Poa* sp.).

Densities and associations of these grass species vary with environmental changes and historical uses across the region. Portions of the grassland type that have been seeded to nonirrigated pasture are comprised mainly of various wheatgrasses, bromes, and timothy, depending on geographic area.

AFFECTED ENVIRONMENT

Mountain Shrub

The mountain shrub community is composed of dense stands of mixed shrubs from 2 to 8 feet in height. The major shrub species of this type are Utah serviceberry (*Amelanchier utahensis*), western or saskatoon serviceberry (*Amelanchier alnifolia*), Gambel oak (*Quercus gambellii*), and, in rocky soils of steep foothills at higher elevations, mountain mahogany (*Cercocarpus* sp.). The herbaceous subshrub understory is dominated by the wheatgrasses, Indian ricegrass, snowberry (*Symphoricarpos* sp.), and antelope bitterbrush (*Purshia tridentata*). When the understory vegetation is influenced by heavy grazing, this type will often close into dense stands of one or more less desirable species, such as Gambel oak or rabbitbrush.

The mountain shrub usually exists as a transition zone between the aspen and sagebrush types. It can also be found completely surrounded by sagebrush. The mountain shrub type typically occurs on slopes and terraces where the soils are well drained. It provides significant big game winter range since these areas generally remain accessible.

Pinyon/Juniper Woodland

The pinyon/juniper type includes both areas that are mixtures of pinyon and juniper and areas that are strictly juniper or pinyon. Northwest Colorado represents the pinyon's northern latitudinal limit. Pinyon, therefore, generally does not occur north of the Colorado-Wyoming border. Historic disturbances such as fire, disease, and chaining have also had an impact on pinyon pine. Pinyon is not as tenacious as juniper after injury; it does not recover readily from root and stem injuries and suffers higher mortality losses.

The soils of the pinyon/juniper type are shallow and often rocky. The growth form is that of an 8- to 20-foot overstory of conifers, with a sparse understory of shrubs and herbaceous species. Crown densities range from quite open (30 percent) to closed (90 to 100 percent). The open stands provide forage for livestock and wildlife, while closed stands usually provide little more than cover.

The dominant species of the pinyon/juniper type are Rocky Mountain juniper (*Juniperus scopulorum*), Utah juniper (*Juniperus osteosperma*), and pinyon (*Pinus edulis*). The understory, though sparse, may consist of Sandberg bluegrass (*Poa secunda*), June-grass, Indian ricegrass, needle and thread, prickly pear cactus, goldenweed (*Happlopappus* sp.), phlox (*Phlox* sp.), and wild cabbage (*Caulanthus crassicaulus*).

The perimeter, or ecotone, of the pinyon/juniper type comprises a mixed association of shrubs, such as sagebrush and mountain mahogany, or grassland/sagebrush.

Saltbush

The saltbush type is characterized by low growing shrub communities which frequently occur in saline-alkaline soils. It occurs in both upland and lowland positions, along flood plains, or along intermittent drainages of semiarid basins. The greasewood and saltbush types appear to be strongly competitive on the lower saline-alkaline soils in low precipitation zones. They are often found intermixed. Understory vegetation varies within this type, depending upon range condition. In poor conditions, there is a high percentage of annual grasses. The saltbush type is generally regarded as valuable winter range for sheep, cattle, antelope, and deer since it occupies lower elevations that do not accumulate large amounts of snow.

The major species of this type are Nuttall's saltbush (*Atriplex nuttallii*), shadscale (*Atriplex confertifolia*), fourwing saltbush (*Atriplex canescens*), Gardner's saltbush (*Atriplex gardneri*), big sagebrush, greasewood (*Sarcobatus vermiculatus*), and horsebrush (*Tetradymia* sp.). Spiny hopsage (*Grayia spinosa*), rabbitbrush, and various grasses may also be found. In Wyoming, bud sagebrush is a major associate of the saltbush community. Plant canopy ranges from 5 to as much as 50 percent.

Greasewood

The greasewood type is located in low elevation drainage bottoms, alluvial fans, and basin flood plains. It may occur on flat or sloping land adjacent to perennial or intermittent streams or washes. The soils are generally saline-alkaline and poorly drained. It is composed primarily of fairly dense stands of medium height shrubs (2 to 6 feet), with a relatively sparse understory.

The dominant plant species of this type is greasewood. Big sagebrush, saltbush, and rabbitbrush may also be present. The herbaceous understory comprises bottlebrush squirreltail (*Sitanion hystrix*), wheatgrasses, alkali sacaton (*Sporobolus airoides*), inland saltgrass (*Distichlis stricta*), and various annual grasses. Densities and species composition vary throughout the region. Dense stands of greasewood provide very little forage for grazing animals. In fact, greasewood can be poisonous to cattle and sheep if consumed in sufficient quantities over a short period of time in the absence of other

AFFECTED ENVIRONMENT

forage. Heavy grazing use of this type, which can occur near watering areas, produces very dense stands of greasewood, with little other vegetation present.

Aspen

The aspen type occurs as open to very dense stands of deciduous trees at 6,000 to 10,000 feet in elevation. These woodlands are dominated by quaking aspen (*Populus tremuloides*), with willow (*Salix* sp.) and serviceberry commonly occurring as the shrub layer. The canopy cover ranges from being relatively open with occasional beaver ponds present, to 70 to 90 percent closed. The often dense understory of the aspen type consists of aspen peavine (*Lathyrus leucanthus*), mountain brome (*Bromus marginatus*), geranium (*Geranium* sp.), bluegrass, skunk cabbage (*Veratrum californicum*), tall larkspur (*Delphinium nelsonii*), cow parsnip (*Heracleum lanatum*), and many others.

The aspen type generally exists along higher elevation drainages, springs, and shaded slopes and as a transition zone between the mountain shrub and conifer type. Growth form varies from dwarfed and twisted stands on snow accumulation sites to merchantable class stands on the fertile sites of national forests. Aspen are clonal in habit, sharing a common root system, and vigorously reproduce in cut or burned areas if parent stock is present.

The aspen community provides important shelter and forage for both livestock and wildlife.

Conifers

The conifer type is confined primarily to the mountainous areas, although there may be a few exceptions. It occurs at elevations of 6,500 to 9,500 feet, where cold temperatures, heavy snows, and rough terrain are the limiting factors.

For the purposes of this document, a number of coniferous species have been grouped to form the conifer type, even though it is recognized that each of them are separate communities in themselves. The species are lodgepole pine (*Pinus contorta*), Ponderosa pine (*Pinus ponderosa*), subalpine fir (*Abies lasiocarpa*), Engelmann spruce, (*Picea engelmannii*), Douglas fir (*Pseudotsuga menziesii*), and limber pine (*Pinus flexilis*). The dominant conifers of this region are the lodgepole pine, Engelmann spruce and subalpine fir. There are isolated locations of ponderosa pine stands scattered throughout the region. Limber pine occurs on harsh sites along windswept ridges and foothills that have rocky shallow soils. Douglas fir occurs on steep

north-facing slopes where snow accumulation is heavy.

Marketability of the conifer type of this region is moderate, as it is for most of the Rocky Mountain area. Forest products include saw timber, house logs, posts and poles, and mine props.

Due to the nature of the coniferous forests, there is little vegetation understory. The conifer type therefore is not an important source of forage, but it does provide cover for both livestock and wildlife. The understory of the coniferous type, though sparse, consists of heart-leaf arnica (*Arnica cordifolia*), huckleberry (*Vaccinium* sp.), mountain brome, lupine, currant (*Ribes* sp.), and aster (*Erigeron* sp.).

Rock Outcrops/Exposed Ridges

This type is defined as those areas where soil, moisture, and climatic conditions are of such severity that only sparse vegetation exists. Rock outcrops and exposed windswept ridges occur. Low growing, cushionlike plants are major components of the living cover. The common species include goldenweed, stonecrop (*Sedum* sp.), phlox, fringed sage (*Artemisia frigida*), buckwheat (*Eriogonum* sp.), catseye (*Cryptantha* sp.), and occasional sagebrush.

For the purposes of this document, barren or badland areas are also included. These sites are characterized by quickly eroding sandstones and shales, which support plants that can tolerate this soil instability. The plant cover is sparse, consisting primarily of saltbush, sagebrush, rabbitbrush, and wheatgrasses. Due to the low densities of the vegetation, this type has little value as a source of forage or wildlife habitat.

Cropland

The croplands of the study region are composed of subirrigated valley bottoms, areas used for hay production adjacent to rivers and streams, and mesas and foothill slopes used for small grain production. Small grain production from the mesas and foothill consists primarily of winter wheat (*Triticum aestivum*) raised by the summer fallow method. The haylands consist of bromes, timothy, wheatgrasses, orchard grass (*Dactylis glomerata*), clovers (*Melilotus* sp.), and alfalfa (*Medicago* sp.).

Many of the areas that are now in small grain production were formerly sagebrush lands. Sheet, rill, and gully erosion are prevalent on small grain and fallow lands, as they are often steep and unprotected from wind and water erosion. Cropland

AFFECTED ENVIRONMENT

provides forage for livestock during times when other grazing lands are not available.

Threatened, Endangered, and Sensitive Plant Species

Field surveys for federally listed threatened and endangered plants and Bureau sensitive or rare plant species were conducted on the 12 tracts in Colorado during the 1982 field season. No known threatened, endangered or rare plants were found at that time.

The U.S. Fish and Wildlife Service, Office of Endangered Species, in Salt Lake City, Utah, was consulted on December 3, 1982, for a biological opinion concerning the federally listed threatened and endangered plant species and the proposed Federal action in Colorado. The U.S. Fish and Wildlife Service in Billings, Montana, was contacted on December 6, 1982, for a list of the federally listed plant and animal species on the five tracts in the Rawlins BLM District in Wyoming. No federally listed plant species are known to occur on the five Rawlins tracts. The Rock Springs District determined that no federally listed threatened or endangered plant species would be affected by the proposed Federal action. They therefore decided that Section 7 Consultation with the Fish and Wildlife Service was not necessary in regard to plant species.

ANIMAL LIFE

Introduction

The affected environment for wildlife is presented in two major sections--Animal Habitat and Animal Populations. Within these sections, aquatic, terrestrial, threatened and endangered species, and wild horses are each discussed separately.

The geographic area for the animal habitat discussion is the same as for the preceding Vegetation section. It consists of the Green River-Hams Fork Coal EIS Round I Habitat Analysis Area, the Southwestern Wyoming Coal EIS Area, and the Meeker and Rangely planning units of the Craig BLM District. Hereafter, this 14.3-million-acre area, which is shown on map 3-1, will be referred to as the habitat analysis area. The emphasis is on vegetation species important to wildlife.

The animal population analysis areas vary, depending upon the availability of data and character-

istics of the population being discussed. For example, a migratory deer herd uses a large land area in the course of its seasonal movements, whereas a trout population may be confined to a single beaver pond year-round. Population analysis areas such as counties, data analysis units, game management units, BLM planning units, EIS areas, or other analysis units, will be used and defined.

Animal Habitat

Habitat has been defined as the sum total of environmental factors--food, cover, and water--that a given species of animal needs to survive and reproduce in a given area (Trefethen 1964). This food, cover, and--sometimes--water is derived from plants. Vegetation communities are essential to animal survival.

The affected habitat types and their importance to key animal species are described in the following section.

Aquatic Habitat

Within the habitat analysis area, rivers, streams, reservoirs, lakes, and ponds support a variety of game and nongame fish, amphibians, and aquatic vegetation. Many terrestrial animals are also dependent upon surface water for survival. Aquatic habitat is scarce and valuable.

Major rivers of importance to aquatic wildlife are the Green, Hams Fork, Little Snake, North Platte, Medicine Bow, Yampa, and White. Flaming Gorge, Fontenelle, Seminoe, and many smaller reservoirs and lakes provide additional important aquatic habitat. In the Wyoming portion of the habitat analysis area, 2,310 miles of stream and 73,000 to 87,000 surface acres of reservoir and lake support game fish (Southwestern Wyoming Coal EIS 1978; Southcentral Wyoming Coal EIS 1978). In Colorado, game fish occur in 478 miles of stream (Green River-Hams Fork Coal EIS 1980; White River Grazing EIS 1980). Total surface acres of lakes and reservoirs containing game fish are not known.

Cold- and warm-water habitat supports both game and nongame fish. Perennial cold-water streams, lakes, reservoirs, and upper reaches of major rivers contain cold-water species such as rainbow, brook, brown, and cutthroat trout; mountain whitefish; and suckers. The Colorado River cutthroat trout, state listed as threatened, and the Bonneville cutthroat trout, state listed as rare, also occur.

AFFECTED ENVIRONMENT

Warm-water, lower elevation reservoirs and portions of major rivers support catfish, sunfish, walleye, bass, minnows, carp, chubs, and dace. Threatened and endangered fishes occurring in warm waters include the Colorado squawfish, bonytail chub, humpback chub, and razorback sucker. These species will be discussed further in the Threatened and Endangered Species section.

Terrestrial Habitat

Eleven terrestrial habitat types, or vegetation types, provide the living space, food, and shelter necessary to support animals within the habitat analysis area. All but the most immobile animal populations use several types. Big game winter range, for example, is composed of six main habitat types--sagebrush, mountain shrub, pinyon/juniper, saltbush, greasewood, and riparian.

Generally, the more important habitats are those which maintain a great diversity of animal species, support a large number of individual animals, or provide an essential element necessary for the survival of a key species. Key species are those animals which have a high economic or recreational value or are rare, sensitive, threatened, or endangered (table 3-13). Tables 3-14 and 3-15 identify vegetation/animal relationships and summarize the descriptions and values of the habitat types. More detailed plant composition and occurrence information is in the preceding Vegetation section of this chapter.

The composition listed for the following habitat types list those plant species important for wildlife. It is provided to reflect animal/plant relationships and thus may differ from the actual composition given in the Vegetation section.

Grasslands (610,192 acres)

Composition of this type includes western wheatgrass, needle-and-thread, Indian ricegrass, Sandberg bluegrass, brome, cheatgrass, and sedge. Grasslands support numerous wildlife species. Key animals include pronghorn antelope, mule deer, ferruginous hawk, golden eagle, and burrowing owl. Many small mammals and birds are produced in this type. Associated predators are abundant due to existence of this prey base. The black-footed ferret, an endangered species, may occur in association with prairie dog towns.

Sagebrush (8,159,644 acres)

The sagebrush type is characterized by the dominance of Wyoming big sagebrush and basin big sa-

gebrush. Black sagebrush, silver sagebrush, bud sagebrush, and fringed sagebrush occur to a lesser degree. Associated grass and forb species are western and bluebunch wheatgrasses, Indian ricegrass, needle-and-thread, junegrass, cheatgrass, arrowleaf balsamroot, phlox, lupine, and rabbitbrush.

This type is essential to the continued survival of sage grouse, pronghorn antelope, and mule deer in the region. Sagebrush is the major source of food and shelter for sage grouse on a year-round basis. The sagebrush type supports high winter concentrations of mule deer and antelope. Birds of prey are common. The black-footed ferret could occur.

Mountain Shrub (729,549 acres)

Typical shrubs found in this type are serviceberry, Gambel oak, mountain mahogany, antelope bitterbrush, and snowberry. Chokecherry and sagebrush are often associated. Understory species include junegrass, mountain brome, Sandberg bluegrass, sedges, yarrow, and arrowleaf balsamroot. Mountain shrub communities are essential to deer and elk survival. Many of the critical winter ranges for these species are in this type. Moose and sharp-tailed grouse occur. Occurrence of vegetation of many height classes allows existence of diverse small mammal and bird populations.

Pinyon/Juniper (805,243 acres)

Rocky Mountain juniper dominates this type. Utah juniper also occurs. Big sagebrush, rabbitbrush, Indian ricegrass, western wheatgrass, prickly pear, antelope bitterbrush, and phlox are typical understory plants. This type provides food and cover for mule deer. Raptors use junipers as nest sites and perches.

Saltbush (959,712 acres)

Nuttall saltbush, fourwing saltbush, and shadscale are dominant. Associated species are big sagebrush, black sagebrush, bottlebrush squirreltail, cheatgrass, Indian ricegrass, western wheatgrass, and Sandberg bluegrass. Animal species composition is similar to that of the sagebrush and greasewood habitat types. Pronghorn antelope, mule deer, and golden eagle are key species. This type can be locally important in supporting wintering pronghorn antelope and mule deer. It seldom provides year-round quality habitat for many animal species. The black-footed ferret could occur.

TABLE 3-13

KEY WILDLIFE SPECIES IN THE HABITAT ANALYSIS AREA 1/

Species	Rationale for Key Designation
Big Game	
Elk	High economic and recreational value
Mule Deer	High economic and recreational value
Pronghorn Antelope	High economic and recreational value
Moose	High economic and recreational value
Game Birds	
Sage Grouse	High interest and recreational value
Sharp-tailed Grouse	High interest
Sensitive Species	
Merlin	High interest
Burrowing Owl	High interest
Ferruginous Hawk	High interest
Golden Eagle	Protected by law
Bonneville Cutthroat Trout	Rare in Wyoming
Fish	
Coldwater Gamefish	High economic and recreational value
Warmwater Gamefish	High economic and recreational value
Threatened and Endangered	
<u>Federal</u>	
Bald Eagle	Protected by law
Whooping Crane	Protected by law
Black-footed Ferret	Protected by law
Colorado Squawfish	Protected by law
Peregrine Falcon	Protected by law
Humpback Chub	Protected by law
Bonytail Chub	Protected by law
<u>State</u>	
Greater Sandhill Crane	Protected by law
Razorback Sucker	Protected by law
Colorado River Cutthroat Trout	Protected by law

1/ Habitat analysis area includes the lower Yampa River.

TABLE 3-14

RELATIVE VALUES OF HABITAT TYPES TO WILDLIFE

Habitat Type	Percent of Total Area	Wildlife Species	Value Rating	Rationale for Rating
Grasslands	4	Rodents, raptors, songbirds	Moderate	Production and species diversity moderate
Sagebrush	57	Mule deer, pronghorn, sage grouse	High	Essential habitat for key species
Mountain Shrub	5	Mule deer, elk, moose, songbirds, sharp-tailed grouse	High	Essential habitat for deer, elk, and moose, important to sharp-tailed grouse
Pinyon/Juniper	6	Mule deer, songbirds, reptiles	High	Important deer winter range
Saltbush	7	Pronghorn, rodents	Moderate	Production and diversity moderate
Greasewood	7	Pronghorn, rodents	Moderate	Production and diversity moderate
Aspen	3	Mule deer, elk, songbirds	High	Species diversity high, deer and elk production areas
Riparian	1	Mule deer, moose, rodents, raptors, songbirds, furbearers, waterfowl	High	Scarce type with high species diversity
Cropland	2	Rodents, songbirds	Low	Monoculture with low diversity
Rock Outcrop-Ridges	1	Rodents, reptiles, raptors	Moderate	Sparse vegetation with low production except for raptors.
Conifers	7	Mule deer, elk, songbirds	Moderate	Seasonally important, cover value good

TABLE 3-15
KEY SPECIES OCCURRENCE AND ABUNDANCE

Animal Species	Habitat Type and Status ^{1/}									
	Grasslands	Sagebrush	Mountain Shrub	Pinyon/Juniper	Saltbush/Greasewood	Aspen	Riparian	Cropland	Rock-Outcrop Barren	Conifer Aquatic
Elk			****			****				****
Mule Deer	****	****	****	****	****	****	****	****	****	****
Pronghorn Antelope	****	****			****					
Moose			**			**	**			
Sage Grouse		****								
Sharp-tailed Grouse		**	**							
Merlin						**	**			
Burrowing Owl	*									
Ferruginous Hawk	***	***			***			***	***	
Golden Eagle	***	***		***	***		***		***	
Coldwater Fish										****
Warmwater Fish										****
Black-footed Ferret	T/E	T/E			T/E					
Bald Eagle							T/E			
Whooping Crane							T/E			
Peregrine Falcon							T/E		T/E	
Greater Sandhill Crane							T/E	T/E		
Colorado Squawfish										T/E
Humpback Chub										T/E
Bonytail Chub										T/E
Razorback Sucker										T/E
Colorado River Cutthroat										T/E

SOURCE: Colorado Division of Wildlife 1978b, 1978c; Southwestern Wyoming Coal EIS 1978; Southcentral Wyoming Coal EIS 1978.

^{1/} **** Common, *** Fairly Common, ** Unusual, * Rare, and T/E Threatened or Endangered

AFFECTED ENVIRONMENT

Greasewood (976,481 acres)

This type is predominantly black greasewood, with rabbitbrush, fourwing saltbush, and some big sagebrush. Wheatgrass, bottlebrush squirreltail, Indian ricegrass, bluegrass, carex, and cheatgrass occur. Animals inhabiting this type are similar to those found in the sagebrush community. Key species are pronghorn antelope, mule deer, and golden eagle. Limited forage and cover is provided by this type. Generally, low animal productivity occurs. The black-footed ferret may occur.

Aspen (395,007 acres)

Quaking aspen dominates this type. Characteristic understory plants are snowberry, carex, larkspur, geranium, mountain brome, timothy, wheatgrass, and bluegrass. Great vegetation diversity allows many animal species to use this type. Deer and elk migration routes and fawning/calving areas often occur in aspen areas. Moose also use this type. Raptors are common nesters.

Riparian (204,306 acres)

Common tree and shrub species are narrowleaf cottonwood, plains cottonwood, box elder, willow, hawthorn, and red osier dogwood. Rushes, sedges, bromes, blue grass, wheatgrass, and cattails occur. The scarcity and diversity of this type makes it valuable. Many bird species, such as songbirds, waterfowl, raptors, and sage grouse, nest and rear young in riparian zones. Deer, elk, and moose find food and cover here. Riparian habitat supports species which are not found in other types--raccoon, mink, and beaver. This is important habitat for bald eagles and greater sandhill cranes and may also be used by peregrine falcons and whooping cranes.

Cropland (339,123 acres)

Within the habitat analysis area, croplands consist mainly of dryland wheatfields and hay meadows, both irrigated and nonirrigated. Hay meadows can be locally important areas for rearing of sage grouse young, which need insects for food. Pronghorn and mule deer use green wheat as a spring food source. Use is limited by a lack of plant species diversity and seasonal availability.

Rock Outcrop/Ridges (155,950 acres)

Sparse vegetation occurs on rocky outcrops, windswept ridges, and other areas with poor soil and low moisture. Vegetation varies from low grow-

ing forms, such as stonecrop and goldenweed, to shrubs, including serviceberry, mountain mahogany, and wild buckwheat. Use is limited by low vegetation productivity. Cliffs are important as nest sites for eagles, falcons, and hawks.

Conifer (947,978 acres)

Dominant plants are Engelmann spruce, subalpine fir, and lodgepole pine. Understory vegetation includes mountain brome, bluegrass, huckleberry, lupine, currant, and aster. This type provides important summer range for mule deer and elk. Trees are used by a wide variety of birds for nesting, perching, and food seeking.

Threatened and Endangered Species Habitat

Individual plant species are listed as threatened or endangered, not vegetation communities which constitute habitat types. However, certain geographical areas, which can include one or more habitat types, may be designated as critical or essential habitat for a threatened or endangered animal species.

No such critical habitats are currently listed by U.S. Fish and Wildlife Service within the habitat analysis area. Essential habitats for threatened and endangered species listed by the state of Colorado do occur. These will be discussed further in the Threatened and Endangered Animals section.

Wild Horse Habitat

Wild horse ranges occur in both the Wyoming and Colorado portions of the habitat analysis area. Primary habitat types used by horses are sagebrush, saltbush, greasewood, and pinyon/juniper.

Animal Populations

A minimum of 68 species of mammals, 189 species of birds, 22 species of amphibians and reptiles, and 22 species of fish occur regularly in the habitat analysis area. The occurrence of many habitat types allows a great variety of animal species to exist.

General life history and occurrence data is available from the states of Colorado and Wyoming and the BLM for most animals in the region. Detailed information on reproductive success and survival rates is known for only a few animal populations. Best data exist for species of high economic or rec-

AFFECTED ENVIRONMENT

reational value such as deer and elk. In recent years, threatened and endangered wildlife species have received more study. Table 3-15 summarizes the affected wildlife resource, with emphasis on key species--those of high value or interest.

Aquatic Wildlife

Nongame Fish

A variety of chubs, dace, carp, suckers, and minnows occur. Population numbers are unknown, but most are common inhabitants of the region's rivers, streams, lakes, and reservoirs. Biomass estimates range from 20 to 90 pounds of nongame fish per acre.

Game Fish

Both cold- and warm-water game fish occur. Species include rainbow, brown, brook, and cutthroat trout, as well as mountain whitefish, walleye, catfish, bass, and sunfish. Highest quality fisheries exist in the upper tributaries and reaches of the Green, North Platte, Yampa, and White rivers and in the Flaming Gorge and Seminoe reservoirs. These fisheries are of high recreational value.

Terrestrial Wildlife

Amphibians and Reptiles

At least 10 species of amphibians and 12 species of reptiles occur within the habitat analysis area. Principal species are boreal toad, leopard frog, Utah tiger salamander, short-horned lizard, northern sagebrush lizard, and prairie rattlesnake.

Population numbers are not known, but most species are common. Limited density estimates range from 2 to 8 animals per acre (Southwestern Wyoming Coal ES 1978).

Amphibians are dependent upon water for reproduction and are generally found in or near aquatic and riparian habitats. The majority of reptiles, on the other hand, occur in lower elevation, dryer habitat types, such as sagebrush, greasewood, and pinyon/juniper.

No widespread regional threat to these animals exists currently. Local declines do not usually result in significant losses to regional populations.

Nongame Birds

A great variety of bird species occurs throughout all habitat types. Songbirds, shorebirds, woodpeckers, and birds of prey are among those present. Densities vary greatly with season and geographic area. An average of 32 nongame birds per square mile is given in the Southwestern Wyoming Coal ES 1978. Limited data from southcentral Wyoming indicates about 21 nesting pairs per 100 acres (Southcentral Wyoming Coal ES 1978).

It is difficult to detect significant changes in songbird numbers without intensive surveys, which have not been conducted for much of the region. Reproductive rates are generally high, so populations can rapidly reestablish themselves after revegetation.

Birds of prey, or raptors, such as the burrowing owl, ferruginous hawk, and prairie falcon, as well as the more common red-tailed hawk and golden eagle, nest within the habitat analysis area. Lack of nest sites and perches can often restrict these birds to a limited number of cliffs or trees, where they concentrate in great numbers. An overall golden eagle density of one bird per 2.5 square miles is reported in portions of the habitat analysis area. Many raptors cannot tolerate human disturbance near their nests, abandoning eggs and young if this occurs.

Game Birds

Sage grouse are the most common and important resident game bird within the affected area. They occur throughout the sagebrush habitat and are dependent upon sage for food and cover. Sage grouse concentrate on strutting grounds, which they re-use annually for mating displays. Strutting grounds, wintering areas, and nesting and brooding areas are essential to population survival.

In Moffat County, Colorado, the population is recovering from severe declines that occurred in the late 1950's through the mid 1960's. Current numbers are estimated to be about 50,000 birds. This level is below historic numbers but does indicate an increasing population.

A total regional population of about 100,000, with an average density of 10 grouse per square mile in all occupied habitats, is reported in the Southwestern Wyoming Coal ES area. Densities ranging from 6 to 18 birds per square mile in southcentral Wyoming are given in the Green River-Hams Fork Coal EIS (1980). No total population for this ES area is reported.

Columbia sharp-tailed grouse occur as separated, small populations in Routt and Moffat counties, Colorado. No estimate of their total numbers is

AFFECTED ENVIRONMENT

available. They are classified as unusual by Colorado Division of Wildlife. They prefer mixed shrub/grass habitats which occur in the mountain shrub, grassland, and sagebrush habitat types. Sharp-tailed grouse, like sage grouse, concentrate each spring on communal breeding grounds. These dancing grounds are known to occur in the Colorado portion of the habitat analysis area.

Other game birds, such as chukar, mourning dove, and blue grouse, are locally or seasonally common. These species do not currently face any significant threat that would cause their populations to decline within the region.

Small Mammals

Many shrews, voles, mice, bats, and ground squirrels are common or abundant within the habitat analysis area. These animals are important food sources for predatory birds and mammals. Generally, occurrence and distribution data is available, but specific population numbers are not known. Animal densities vary greatly both seasonally and year-to-year. Estimates of 0.5 to 60 per acre are reported for the region (Southwestern Wyoming Coal ES 1978; Federal Coal Management Programmatic ES 1979).

The reproductive rates of most of these small mammals are high, enabling rapid population expansion if environmental conditions are favorable, i.e., food and cover are available. Localized population losses do not usually result in regional declines.

Elk

Most elk populations within the habitat analysis area are migratory. Summer ranges occur in the aspen and conifer habitat types of the Medicine Bow and Wasatch national forests in Wyoming and in the Routt and White River national forests in Colorado. These animals move to lower elevation mountain shrub and sagebrush winter ranges in fall. Overall populations are stable to increasing.

Elk in Colorado data analysis units E-2, E-5, E-6, and E-21 (map 3-2) are dependent upon winter ranges in the Yampa River and White River drainages. Many of these animals migrate through, calve, or winter on or near proposed lease tracts. Total elk population in this 4,960 square mile winter range area was estimated to be 25,831 animals in 1982.

The average winter densities in 1982 ranged from 5 to 26 elk per square mile in these units. Many smaller areas within these game management units support concentrations much higher due

to more favorable conditions. In the area near Meeker, Colorado, 50 elk per square mile regularly occur in winter.

In Wyoming's southwestern coal ES area, a total of 5,750 elk, with an overall density of 6 per square mile, was reported in 1978. The total population estimate for the Carter Lease, Steamboat, and Little Mountain Pine Mountain herd units was 980 elk (Wyoming Game and Fish Dept. 1981; Rock Springs BLM 1983). Elk do not regularly use the proposed lease tracts in this area.

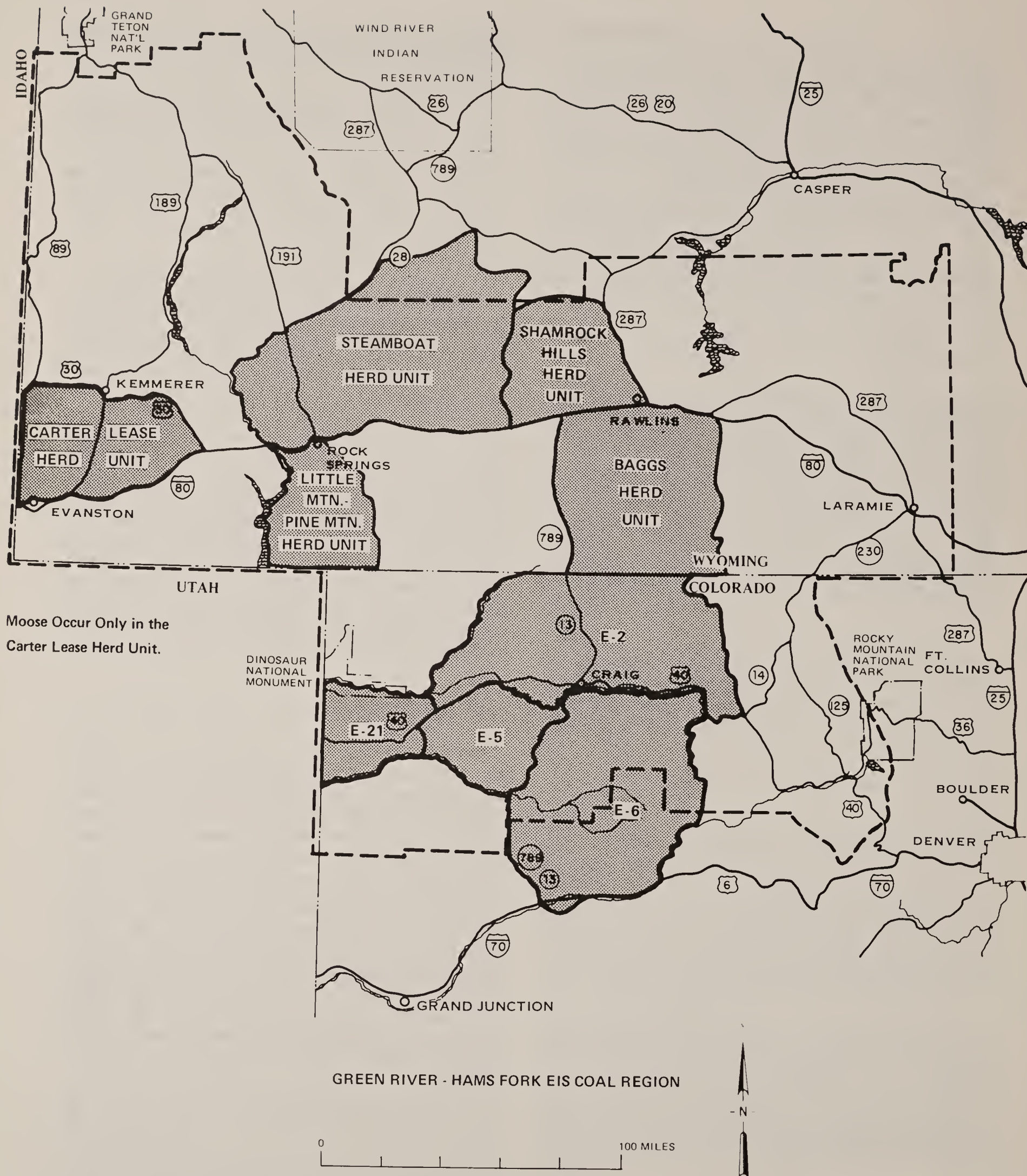
An estimated 4,500 elk occur in the Baggs Herd Unit (map 3-2) of southcentral Wyoming (Rawlins BLM 1983). The estimated density on winter range would be 13.2 elk per square mile. An additional 60 animals inhabit the Shamrock Hills Unit. The total elk population of the Southcentral Wyoming Coal EIS area was estimated to be 5,500 to 7,500 animals in 1978. Migration routes and crucial winter ranges for the Baggs herd occur on and near proposed lease tracts. Elk densities in these areas increase greatly in winter. An ongoing study is designed to determine the importance of these proposed lease tract areas to herd survival. The study is being conducted by the U.S. Forest Service's Rocky Mountain Forest and Range Experiment Station in Laramie, Wyoming, with BLM and Rocky Mountain Energy Company as cooperating parties. It will be completed in 1986.

Mule and White-tailed Deer

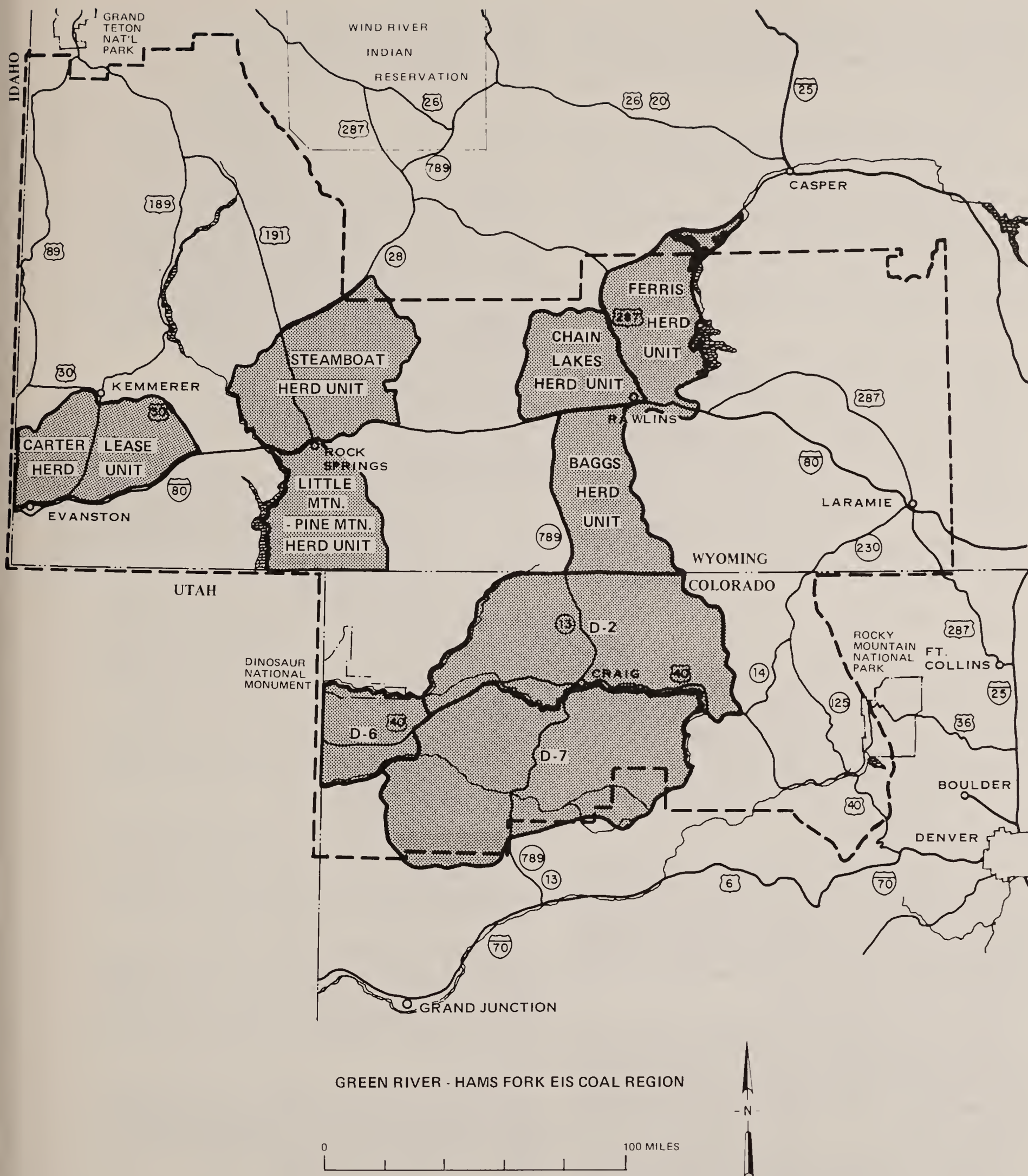
White-tailed deer are uncommon in the habitat analysis area. A population of 200 to 250 exists in the Southcentral Wyoming Coal EIS area. No additional specific data is available on their occurrence and distribution, but they are generally associated with river-bottom riparian habitats.

Mule deer are common in nearly all habitat types. Many migrate between aspen/conifer summer ranges and sagebrush/mountain shrub winter ranges. Some occupy shrublands year-round. Available winter range is limited. This results in crowding, high utilization of vegetation, and deer die-offs when weather conditions are severe. The habitat analysis areas population numbers are stable to slightly increasing. Some local populations may be declining.

The 1982 winter population in Colorado data analysis units D-2, D-6, and D-7 (map 3-3) was estimated at 108,358 animals over a winter range of 4,414 square miles. The Colorado Division of Wildlife's herd objective for these data analysis units is to maintain these numbers. This winter range supported an average density of 25 deer per square mile. Densities exceeding 50 per square mile occur



Map 3-2. Elk and Moose Analysis Areas



Map 3-3. Deer Analysis Areas

AFFECTED ENVIRONMENT

where conditions are favorable, i.e., snow free, protected areas. These winter ranges in the Yampa River and White River drainages are essential to herd survival. Proposed lease tracts occur in these areas.

Total Southwestern Wyoming Coal EIS area mule deer numbers were estimated to be about 21,000 animals in 1978. An overall density of 6 per square mile existed. The total population in the Carter Lease, Steamboat, and Little Mountain-Pine Mountain herd units was estimated at 19,000 in 1981 (Wyoming Game and Fish Dept. 1981). Winter concentration areas occur, with up to 14 per square mile on some of the proposed coal tracts (Site Specific Analyses 1982).

Within the Southcentral Wyoming Coal EIS area, the mule deer population was estimated at 18,000 animals in 1982 for the Baggs, Ferris, and Chain Lakes herd units (map 3-3). Animal densities on winter ranges averaged 10.2 deer per square mile. Total population of the area was given as 17,000 to 21,500 in 1978. Average densities would have ranged from 10 to 13 deer per square mile on all winter range, but higher localized concentrations would have occurred. Winter ranges exist on and near proposed coal lease tracts.

Pronghorn Antelope

Pronghorn are common year-round throughout the lower elevation habitats--sagebrush, saltbush, and greasewood. Some herds are migratory and move to winter concentration areas. Movement patterns may be influenced and altered by manmade barriers--fences, roads, and canals, for example. Such restriction may lead to overuse of vegetation and declines in local herds. Generally, regional populations are increasing.

A winter population of 5,953 antelope was estimated in Colorado Antelope Analysis Areas A-9, A-10, and A-21 in 1982. Most of these animals occurred in the west of Craig in Area A-9 of Moffat County (map 3-4). Antelope ranges occur on proposed coal lease tracts. No serious threat to their overall survival currently exists.

About 17,000 pronghorn occurred in 1978 in the Southwestern Wyoming EIS Area. The winter range average density is given as 10 per square mile. Up to 23 animals per square mile occur on some of the proposed lease tracts in the area (Site Specific Analyses 1982).

Pronghorn numbers in 1982 totaled about 34,000 in the Baggs, South Ferris, and Red Desert herd units of southcentral Wyoming (map 3-4). Average winter density was 9.4 antelope per square mile. The total 1978 population for the Southcentral EIS

area was estimated at 34,000 to 40,000 animals on 1,510 square miles of winter range, or 22 to 27 animals per square mile. Crucial winter ranges occur on and near proposed coal lease tracts.

Moose

Moose are found only in the western one-third of the Southwestern Wyoming Coal ES area. They are mainly confined to riparian zones along major drainages, with some use of the upland mountain and aspen shrub habitats occurring. A total population of 1,475 animals is given in the Southwestern Wyoming Coal ES (1978). The Carter Lease Herd Unit population was estimated at 100 in 1981 (Wyoming Game and Fish Dept. 1981).

Threatened and Endangered Animals

One mammal, four bird, and five fish species listed as threatened or endangered by the U.S. Fish and Wildlife Service or the state of Colorado may occur in the habitat analysis area. Wyoming does not have a state listing. Table 3-16 lists each species, along with its status and occurrence.

In Colorado, there have been no confirmed sightings of black-footed ferrets in over 30 years. However, high potential exists for locating the black-footed ferret in the Wyoming portion of the habitat analysis area. Prairie dog towns which represent potential habitat occur on and near proposed lease tracts.

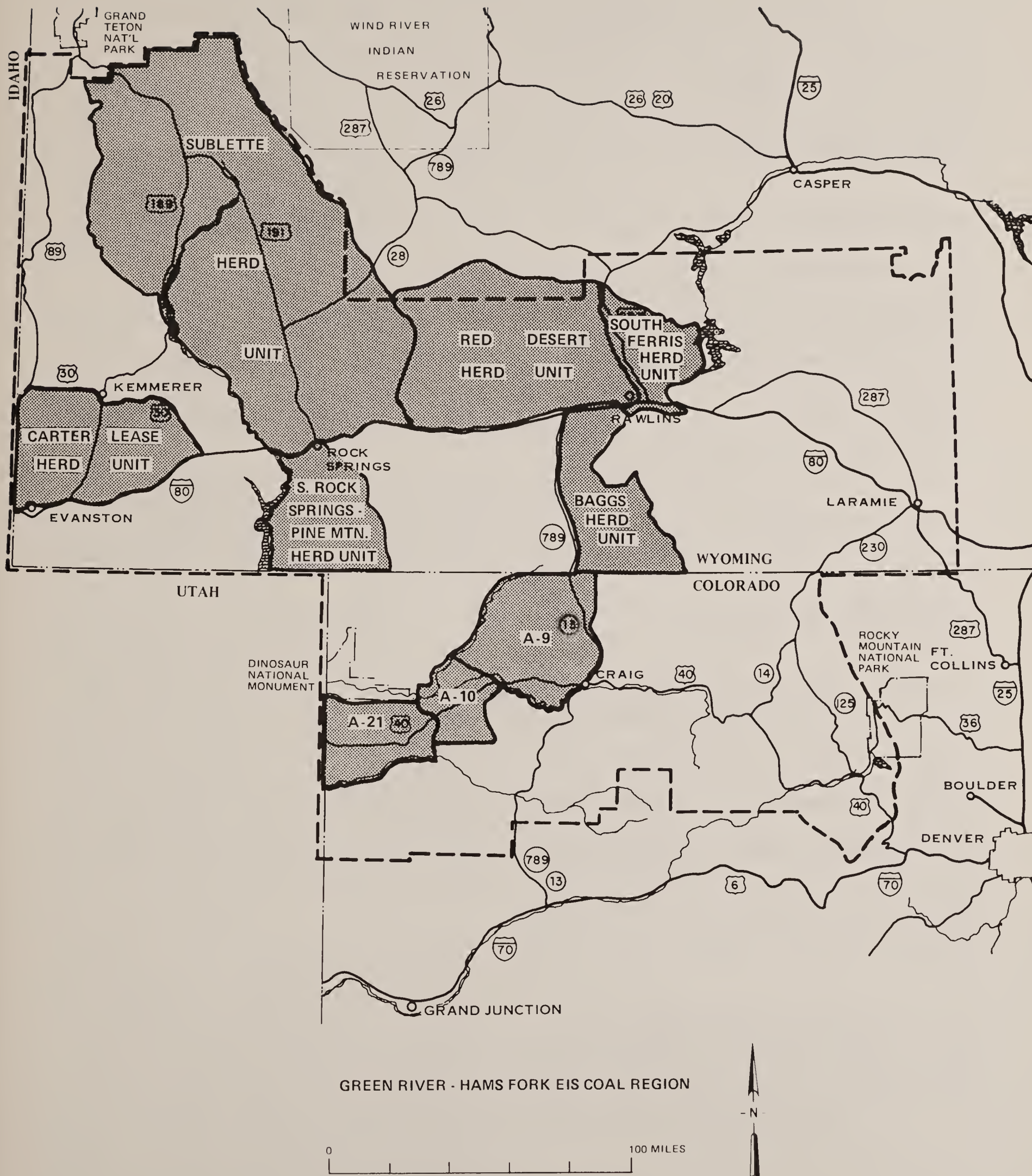
Bald eagles are winter residents and occasional breeders in the habitat analysis area. They concentrate along the Yampa, White, Little Snake, North Platte, and Medicine Bow rivers.

Whooping cranes migrate across Wyoming and Colorado portions of the habitat analysis area. They may occasionally nest or feed for brief periods on or near proposed coal lease tracts, but no affected concentration areas are currently known.

The American peregrine falcon, federally listed as endangered, migrates through the area. It is known to nest within the Wyoming portion of the habitat analysis area near Flaming Gorge Reservoir and the Green River (Southwest Wyoming Coal ES 1978).

Essential habitat for a state listed endangered bird, the greater sandhill crane, occurs in Routt and Moffat counties, Colorado (Colorado Division of Wildlife 1978d). This bird nests along willow lined drainages in the riparian habitat.

The Yampa and White rivers in Colorado are habitat for three Federally listed and one state listed threatened or endangered fish species. In ad-



Map 3-4. Pronghorn Antelope Analysis Areas

TABLE 3-16

THREATENED AND ENDANGERED WILDLIFE IN THE HABITAT ANALYSIS AREA 1/

Species	Status <u>2/</u>	Occurrence
Black-footed ferret	E (F,S)	Possibly in Colorado and Wyoming
Bald eagle*	E (F)	Colorado and Wyoming
Whooping Crane	E (F)	Colorado and Wyoming
Greater sandhill crane*	E (S)	Colorado
Peregrine falcon*	E (F,S)	Colorado and Wyoming
Bonytail chub	E (F,S)	Possibly in Yampa and White Rivers
Colorado River cutthroat trout*	T (S)	Colorado and Wyoming
Colorado squawfish*	E (F,S)	Yampa and White Rivers
Humpback chub*	E (F,S)	Yampa River
Razorback sucker*	T (S)	Yampa River

SOURCE: Colorado Division of Wildlife; Southwestern Wyoming Coal EIS 1978; Southcentral Wyoming Coal EIS 1978.

1/ Includes the lower Yampa River.

2/ T = Threatened; E = Endangered; (F) = Federal list; (S) = State list.

* Known to occur in the habitat analysis area within the last five years.

AFFECTED ENVIRONMENT

dition, one fish species (Colorado River cutthroat trout) that is state listed inhabits upper reaches of the Little Snake River and Lake Creek.

All threatened and endangered species are protected by law. The required consultations with the U.S. Fish and Wildlife Service and the state of Colorado have been initiated by letters dated December 3, 1982. Replies have not yet been received. In Wyoming, the Rawlins BLM District is currently preparing a biological assessment to determine if listed species may be affected. The Rock Springs BLM District has determined that consultation is not needed since no listed species would be impacted.

Wild Horses

Wild horses occur in both the Wyoming and Colorado portions of the habitat analysis area. Numbers are much higher in Wyoming, with a total of about 4,500 animals reported for the southwestern and southcentral EIS areas in 1978.

In Colorado, the Douglas Creek Herd which occurs in the Rangely Planning Unit, numbers about 175 horses (White River Resource Area Grazing Management EIS 1980). No other Colorado population is on or near any proposed lease tract.

CULTURAL RESOURCES

There currently exists no reliable method to predict numbers of cultural resources per acre in the Green River-Hams Fork Coal Region. A prediction of this sort would require a fuller understanding of prehistoric and historic cultures, environments, resource procurement strategies, site selection criteria, and the changes that environmental and cultural variables underwent from 11,000 B.C. to the present. At current levels of the cultural resource data base and its statistical manipulation, this information is not available.

Presently, there is one Wyoming site, 48CR256, within the Leucite Hills coal tract that has been formally determined to be eligible for inclusion on the National Register of Historic Places by the Keeper of the National Register. An additional 117 cultural resources are known to exist within the Wyoming coal tracts. Of this total, 94 resource sites need more data collection efforts to determine their eligibility to the National Register. Six sites have been determined eligible to the National Register by the BLM but no further formal determination has been carried out as yet. Finally, 17 sites in Wyoming have been recorded sufficiently to collect all data

present. These sites are not eligible to the National Register (table 3-17).

In Colorado there are 136 known cultural resource sites on the coal tracts. Of these, 29 sites need more data collection efforts to determine their National Register eligibility. Data collection efforts on 107 cultural resources have been completed and these sites have been determined not to be eligible to the National Register of Historic Places (table 3-17).

A summary of cultural resources by coal tract and alternatives is presented on table 3-17.

Land areas within the coal lease areas that have not been surveyed for cultural resources at a Class III (100 percent) level of intensity would be surveyed prior to any ground-disturbing activities. This would also pertain to off-tract disturbance associated with the coal leasing activities. Cultural resources located during this phase, as well as those discussed above, would be evaluated by BLM, in consultation with the State Historic Preservation Officer, for their eligibility for inclusion on the National Register.

Cultural resource site types within the Green River-Hams Fork Coal Region are described in tables 3-18 and 3-19. The types of known sites identified in the coal lease tracts are prehistoric lithic scatters, campsites, rock art sites, tipi rings, and historic homesteads, stage roads, and trash dumps.

Consultation with the Wyoming and Colorado State Historic Preservation Officers has been completed. This was done to inform them of the proposed actions and receive their comments. A review of the National Register of Historic Places and its latest supplement in the Federal Register (February, 2, 1983) has also been completed. This was done to determine if any National Register site would be affected by the proposed leasing. The review indicated that no cultural resources currently listed on the Register were within the coal lease tracts. However, numerous sites on the tracts either are, or may be, eligible for inclusion on the Register.

The Green River-Hams Fork region has been inhabited for at least 10,000 years. Surface finds and limited excavations have provided carbon-14 dates and cultural material evidence of these cultures (Frison 1978). Table 3-20 presents a general chronology of the archaeological periods.

TABLE 3-17
KNOWN CULTURAL RESOURCES

Alternatives	Potential National Register Quality Sites (BLM)*	Potential National Register Archaeology District (BLM)**	Total Known Sites	Need More Data for National Register Determination	Potentially Eligible to the National Register***	On National Register	Not Eligible	Percent of Tract Surveyed (Class III)	
<u>LOW</u>									
Deadman	x		1		1			0	
Leucite Hills	x	x	9	9				5.0	
Point of Rocks	x		16	15			1	42.0	
Tract 98								100.0	
Prairie Dog	x		118		16		102	71.2	
Little Middle Creek								10.1	
Middle Creek								0	<u>144</u> Total known sites
<u>MODERATE</u>									
Atlantic Rim	x		19	14	3		2	17.0	
Byrne Creek	x	x	5	4			1	0.1	
Corral Canyon	x		44	31		1	12	93.0	
Wild Horse Draw								0.5	
Rattlesnake Mesa			1				1	35.0	
Signal Butte								0.4	<u>213</u> Total known sites
<u>HIGH</u>									
Pio	x		3	2	1			5.0	
Winton	x		5	3	1		1	11.0	
Indian Springs	x		15	15				90.0	
Peck Gulch								12.0	
Iles Mountain								59.7	
Fish Creek			3				3	55.2	<u>239</u> Total known sites
<u>MAXIMUM</u>									
Northeast Cow Creek	x		1	1				2.0	
Bell Rock			1				1	9.3	
Williams Fork Mountain								10.1	
Lay Creek	x		13	13				0	
Horse Gulch								4.9	<u>254</u> Total known sites
24	12	1	254	107	22	1	124		

- * BLM has determined that some known cultural resources are potentially eligible to the National Register of Historic Places. No further formal determination has been carried at this time.
- ** BLM has determined that a large area of this tract may be potentially eligible to the National Register of Historic Places. No further formal determination has been carried out at this time.
- *** BLM has determined through in-house evaluation that, at a minimum, the following numbers of cultural resources are potentially eligible to the National Register. No further formal determination has been carried out at this time.

TABLE 3-18

ARCHAEOLOGICAL SITE TYPES

Kind	Characteristics
Lithic scatter (open lithic; chippings; chipping station)*	Area where the waste from the manufacture of stone tools or the tools themselves are found.
Campsite (habitation; camp; burnt spots; fire pots; hearths)	A lithic scatter with the addition of features connected with fire making: charcoal, ash, fire cracked rocks, or burnt bone. A campsite may also be just a hearth, with no associated cultural materials.
Quarry (chippings; manufacturing areas)	An area containing a natural source of rocks suitable for making tools. Unmodified rock, waste, and tools in all stages of manufacture are found.
Kill site (trap; jump)	An area containing stone and/or bone tools in association with the remains of one or more animals.
Rock shelter (cave; overhang)	An area protected from the weather by an overhanging rock formation. Usually has a drip line. May or may not have surface culture material.
Rock art	Any artistic expression or message on a rock surface.
(a) pictograph	(a) Painted figures of people, animals, plants, letters, numbers, or abstracts.
(b) petroglyph	(b) Incised figures of people, animals, plants, letters, numbers, or abstracts.
Burial	Remains of human beings, fragmentary or whole.
Tipi rings (stone circles, tipis)	Circular arrangement of spaced rocks, 3 to 15 m in diameter.
Wickiup (tipi poles)	Poles or branches of pinyon or juniper laid up against living trees. Interior floored with juniper bark.
Granary (cist, corncrib)	Mud-mortared sandstone slab structures, usually about 1.5x1.5x1.5m. Most often built into sandstone ledges, sometimes mud lined and capped or lidded with a large slab.
Rock walls (forts)	Alignments or walls of mud-mortared or dry-laid stone masonry. May be single or multiple. May have "doorway," usually built on ridge.

* Words in parentheses are synonyms for that kind of site.

TABLE 3-19
HISTORIC SITE TYPES

Kind	Characteristics
Trails	Identified routes followed by early explorers or by many emigrants. Physical evidence may (Overland) or may not (Domínguez-Escalante) remain.
Forts	Military establishments for the protection of persons or property. Also gathering and exchange points prior to the establishment of towns.
Stage Stations	Wayfarers' resting places and fresh harness animal acquisition points.
Homestead	One or more structures of varied size, shape and materials used to shelter isolated Euro-American families claiming land under various homestead laws.
Ranch	Cluster of structures of single and multiple uses associated with a livestock-based family economic operation.
Railroad	Roadbed, tracks, trestles, bridges, depots and rolling stock associated with early (and continued) industrial transportation of goods and people.
Town	Aggregation of structures sheltering domestic, business, educational, social, political and religious activities. Individual structures may be single or multiple use, but population is multifamily.
Unique Structure	Any structure whose merit is associated with a particular person.
Site	The location where a historic event occurred but not tangible evidence remains of the action itself.
Architectural	A structure whose merit is its manner or style of construction.
School	A structure built for educational purposes but whose historical function is as a community center in the absence of nearby towns.
Community Center	A structure, often a public school, which provides a relatively local meeting place for residents of areas with few towns.
Mine	An outcropping of valuable mineral resource and the structures associated with the removal activity.
Reclamation Projects	Structures associated with irrigation, water and soil retention or flood control. Usually, these are engineering features.

TABLE 3-20
CHRONOLOGY OF EIS REGION

Paleo-Indian	Pre-dating 10000 BC - small bands of nomadic hunters and gatherers; big game based economy; large, well-made lanceolate and sometimes fluted projectile points
Early Archaic	7000-5000 BC -nomadic bands of hunters and gatherers; broad-based subsistence; large side-notched points common
Middle Archaic	5000-3500 BC - same as Early Archaic with increasing groundstone; large to medium stemmed points common
Late Archaic	3500 BC-AD 900 - same as Middle Archaic with incipient horticulture; medium corner-notched points common; introduction of the bow and arrow and ceramics
Fremont	AD 900-1250 - semi-sedentary to nomadic small groups of hunters, gatherers, and horticulturalists; ceramics, distinctive rock art motifs, and small corner-notched points
Proto-historic (Numic)	AD 1150-1880 - nomadic hunters and gatherers; small game based economy with big game adaptations; ceramics and small unnotched or side-notched points; thought to be Numic-speaking groups that developed into the Ute and Shoshoni peoples ethnographically documented for the region; later Period traits include equestrian and horse rock art motifs, European trade goods, wickiups, and a possible increase in the use of obsidian
Historic	AD 1860-1932 - end of aboriginal occupation and introduction of Euroamerican settlement; homesteads, transportation corridors, and limited ranching and hay farming; minerals development

AFFECTED ENVIRONMENT

RECREATION, VISUAL, AND WILDERNESS RESOURCES

Recreation

The affected area for recreation includes Moffat, Rio Blanco, and Routt counties in Colorado and Carbon, Sweetwater, Uinta, and southern Lincoln counties in Wyoming. Communities within this region provide an important recreation resource.

Urban Recreation

Urban recreation facilities available to the public in the vicinity of the proposed coal lease areas vary widely. Most communities have a shortage of facilities and are now implementing plans to help meet present and expected recreation demands caused by population growth, which is directly related to energy development. Populations have stabilized, at least for the present, in most areas and have actually declined slightly in some communities. This has allowed for planning and some development of needed park and recreation facilities to help meet the present demand. However, small towns such as Dinosaur, Colorado, have been unable to meet demands as a result of recent rapid growth. This is due to lack of capital and time needed to develop new recreation facilities.

In 1982, the Colorado Department of Local Affairs, through a grant, sponsored a program to provide summer recreation programs to small communities which probably would not otherwise have these opportunities. This will help provide recreation opportunities in Hayden, Meeker, Oak Creek, and Dinosaur at least through 1984.

The larger communities in the region are now developing new facilities. Rock Springs and Green River, Wyoming, as well as Rangely, Colorado, have applied for lease of public lands under the Recreation and Public Purposes Act for construction of recreation facilities or complexes. Rawlins, Wyoming, has plans for new park and recreation facilities and is capable of responding to increased demand from urban growth. Both Meeker and Rangely, Colorado, have formed recreation districts which are capable of meeting most if not all of the urban recreation needs in Rio Blanco County. With the development of these facilities, the present demand for activities, especially during the winter months (October to May), should be met in these areas in the near future. Existing facilities in the other communities are primarily for moderate weather activities, thus providing a shortfall for some winter indoor activities.

The Wyoming State Comprehensive Outdoor Recreation Plan identified the need for additional recreation areas and facilities, especially for municipalities, through 1990. Specific needs exist for picnic areas, tennis courts, campsites, golf courses, swimming pools, baseball fields, and municipal park acres. The Colorado State Comprehensive Outdoor Recreation Plan identifies picnicking, swimming, bicycling, and dayhiking as 'high need' activities. Some facilities for these activities already exist or are planned by city, county, or recreation districts.

All the communities in the region rely upon school playgrounds, high school playing fields, and fairgrounds, as well as city and county facilities, as major urban public facilities for year-round recreation activities. Privately owned facilities used by adults include bars, restaurants, theaters, bowling alleys, and health clubs, which are generally provided as demand and economic feasibility dictate. School districts, social clubs, churches, organizations, and community sponsored activities also play a role in meeting recreation needs.

The primary recreation issue in the EIS area is the availability of funds for development and the increasing operation/maintenance costs of recreation areas and facilities. Other urban recreation issues include increased demands on austerity budgets; lack of coordination between school districts, local governments, and other agencies and organizations; development of intensive use facilities to meet urban needs; and information dissemination. The most important factor in the region is energy development and its subsequent impact on recreation resources.

Dispersed Recreation

Public lands within the EIS area account for a majority of the land area used for dispersed recreation activities. Opportunities for almost all types of motorized and nonmotorized forms of dispersed outdoor recreation are available. The most popular activities include hunting, fishing, hiking, camping, horseback riding, water oriented activities, picnicking, sightseeing, and winter sports.

Big game hunting is perhaps the most intensive, shortest-use season activity in the study region. Hunting in Colorado and Wyoming is of national significance, attracting out-of-state use. Approximately 20 to 30 percent of big game licenses sold by state game departments are purchased by non-resident hunters. With the increased Colorado population and open license sales to nonresident hunters, numbers of hunters, as well as revenues, have increased. Wyoming license sales are presently limited in number to out-of-state participants, holding

AFFECTED ENVIRONMENT

hunting pressure at a manageable level. Wyoming increased all nonresident hunting and fishing license fees in the 1980 season. Increased revenues should now be providing for better management of game populations.

Camping and picnicking are popular recreation activities in the region. The U.S. Forest Service, National Park Service, Bureau of Land Management, U.S. Fish and Wildlife Service, Colorado and Wyoming Parks and Recreation Departments, and Fish and Game Divisions provide both undeveloped and developed sites within the region.

The National Park Service reports that overall visitation in the Rocky Mountain Region remains static. However, Dinosaur National Monument had a 9 percent increase, while Fossil Butte National Monument experienced a 6 percent increase in visitation over the last three years. Increases of approximately 5 to 10 percent in overall visitation have been reported for the Routt, White River, and Medicine Bow national forests over the past year. Flaming Gorge National Recreation Area also reports an 8 percent increase in visitation, with floatboating on the Green River, in particular, on the rise.

Fishing for both warm and cold water fish has the highest participation of any dispersed recreation activity. Primary lakes used are Steamboat, Peal, Avery, Trappers, Ralph White, Rio Blanco, Vaughn, and Elkhead in Colorado and Flaming Gorge, Fontenelle, Big Sandy, Seminoe, and Pathfinder in the Wyoming region. Popular rivers include the North Platte, Little Snake, Bear, and Green in Wyoming, with the Yampa, Elk, Green, and White rivers being the most popular in Colorado. Many smaller streams, lakes, and reservoirs located in the Medicine Bow, Routt, and White River national forests are popular for fishing. The majority of other water oriented recreation takes place in the areas just mentioned. Those activities with the highest participation are power boating, swimming, water skiing, and floatboating.

Demand for recreation use of rivers is high and increasing annually, especially for floatboating. The Yampa and Green rivers in Dinosaur National Monument are nationally known for their whitewater floatboating opportunities, for which demand cannot be met due to the limited number of permits. The North Platte is also considered a popular floatboating river in Colorado and Wyoming as well as the Green River below Flaming Gorge in Utah. As visitor numbers become regulated on more Western rivers to prevent overuse, the recreational significance of other lightly used rivers becomes more important. The Colorado State Comprehensive Outdoor Recreation Plan (SCORP) recognizes the need for protection of rivers as valuable recreation

resources. There is also a recognized need for the different recreational opportunities provided by reservoirs. This is both a state and national issue.

Portions of the Yampa, Green, Elk, and Encampment rivers in Colorado have been recommended for inclusion into the National Wild and Scenic Rivers system. Designation of these rivers is pending Congressional action, which is not expected soon, if at all. Segments of the Encampment and North Platte rivers in the Medicine Bow National Forest in Wyoming are also eligible for Wild or Scenic River designation. There are no designated wild and scenic rivers in or near any of the proposed lease areas.

Several other river segments are on the National Park Service Nationwide Rivers Inventory list, which recognizes outstanding values of significant free flowing rivers. These rivers include segments of the Yampa and White rivers in Colorado and segments of Fontenelle Creek and the Hams Fork in Wyoming. These river segments are in a relatively natural and undeveloped condition but would require Congressional action to be studied for possible inclusion into the Wild and Scenic Rivers system. None of these rivers is now subject to protection.

Off-road vehicle use is generally a secondary form of recreation, a means of travel to reach a specific destination for hunting, fishing, camping, or other activities. As a primary use, off-road vehicle activity is limited to low numbers, usually involving clubs or organizations utilizing trail bikes, snowmobiles, and four-wheel drive vehicles. There is an abundance of public land for this activity. However, BLM may limit or close public lands to off-road vehicle use in areas where damage is evident to or threatening natural resources.

Horseback riding, hiking, and backcountry camping are also considered high participation activities in the region. The vast quantity of accessible public land allows for these activities in a wide array of topographic and vegetation environments and is quite common in undeveloped areas of the region.

Winter activities such as downhill skiing, cross-country skiing, snowmobiling, sledding, and ice fishing are significant recreation activities from November through March in the region. The majority of these activities take place on public land administered by the U.S. Forest Service. There is a surplus of public land, primarily BLM, available for winter sports activities.

Recreation activities with low participation or occurring as secondary activities are rock hounding, wildlife observation, arrowhead collecting, general sightseeing, and historical site visitation, among others.

AFFECTED ENVIRONMENT

Recreation is of economic benefit to both Colorado and Wyoming. For example, while tourism is down very slightly in Colorado, revenues are up. A recent study completed by Colorado State University (McKean and Nobe 1983) shows that over \$1 billion were put into the Colorado economy from hunting and fishing activities alone statewide in 1981. This rivals the Colorado ski industry. Revenues are expected to continue increasing, because recreation areas will produce economic benefits indefinitely if the resource is maintained and well managed.

Historically, holiday weekends produce overcrowding of all popular areas and developed facilities, and this situation is expected to continue. There is generally an excess of public lands for most dispersed motorized recreation activities within the study region. However, there is a need for additional trails, developed camping areas, nature study areas, and lake boating in general closer to the more populated communities in the study region. In addition, roadless areas providing primitive recreation opportunities are declining in the region, while demand for these opportunities continues to increase.

Visual Resources

The scenic quality of the study region reflects the great diversity of topography and vegetation communities present. Public agencies have the responsibility to protect visual resources on public land and even on private surface when mineral rights are government owned and leased for development. A method of categorizing scenic values has been established to provide a means of implementing all types of manmade intrusions on various landscapes. Visual resource management (VRM) classifications have been applied to lands in an effort to protect them while allowing various types of uses that may be compatible with scenic quality. The classifications are defined in the Glossary.

Class I and II are the most restrictive in terms of allowable landscape changes. Portions of the Middle Creek, Rattlesnake Mesa, and Bell Rock tracts and all of the Atlantic Rim Tract are VRM Class II; the rest of the tracts are VRM Class III.

Scenic Quality

Elevation ranges from valley floors at about 5,200 feet above sea level to a high point of 12,180 feet. This variation in elevation causes significant differences in climate, resulting in a wide range of vegetation and scenic landscape categories.

Outstanding alpine scenery, consisting of high rock faces; precipitous, rugged slopes; and numerous natural and beaver-built lakes, ponds, and streams, provide for some of the most outstanding, awe-inspiring visual experiences in the United States. The highest visual resource management (VRM) classifications are usually applied to this type of landscape, i.e., Class I or II.

Forested areas are common in the region. Aspen, spruce, Douglas fir, Ponderosa pine, lodgepole pine, and subalpine fir are the predominant species within this landscape type. Abundant streams, beaver ponds, and grass meadows are present. The variety of color, line, form, and texture makes these areas outstanding for scenic observation. The river valleys below, with their riparian vegetation in a semiarid climate, are also quite scenic. VRM Class I, II, or III is most frequent in these areas.

Mountain shrub communities lie below the forests, adding to vegetation variety. Predominant species are Gambel oak and serviceberry. These areas are generally very dense and lie on steep to moderate slopes. Mountain shrub communities usually fall into VRM Class III and IV. This type of landscape is generally considered to be of average scenic quality. However, it does provide more varied topography and vegetative relief than the rolling sage covered hills.

Another landscape type which is scattered throughout the region is pinyon/juniper woodland, located on areas having steep to moderate terrain and with shallow soils. The topography can make these areas very scenic, with colorful rock outcrops; variation in color of soil; and deep ravines, canyons, or washes. Class II, III, and IV are the most common VRM classifications for pinyon/juniper areas.

Some of the badlands areas located on both sides of the Colorado-Wyoming border are considered high quality scenic landscapes due to their rugged terrain, lack of vegetation, wide range of rock and soil coloration, numerous vistas, and changing appearance during different phases of natural lighting throughout the day. VRM Class II, III, or IV may be applied to such areas.

The last and most predominant landscape type in the region is rolling sagebrush covered hills. This landscape is probably the least scenic in the region. VRM Class III and IV are the most common classifications of these areas.

Visual Sensitivity

Visual sensitivity deals with the number of individuals viewing an area and how they perceive a par-

AFFECTED ENVIRONMENT

ticular landscape. For example, the roads through oil and gas or coal fields in the region are used primarily by individuals working as miners or oil and gas workers. They may perceive the oil and gas well or coal mine as an insignificant intrusion upon the landscape since it is directly related to their livelihood. On the other hand, the tourist or sightseer may perceive this development to be a major intrusion upon the landscape. Landscapes viewed from well traveled transportation routes generally have high visual sensitivity.

The majority of the regional landscape remains in a relatively natural, undeveloped condition. Major manmade intrusions upon the landscape include coal mines, power plants, oil and gas fields, roads, powerlines, railroads, pipelines, and urban areas. An estimated 161,948 acres have been disturbed by these developments in the region. The severity of the developments on the visual resource varies considerably. Most of these disturbed areas are considered to be VRM Class V until successful reclamation has been completed.

Wilderness Values

Existing designated wilderness areas within and adjoining the study region contain 390,308 acres of primitive environment managed by the U.S. Forest Service. The largest of the three areas is the Flat Tops Wilderness, with 235,230 acres, followed by Mount Zirkel, with 139,818 acres; both are located in Colorado. The Savage Run Wilderness Area in Wyoming contains 15,260 acres. Portions of all three wilderness areas are outside the seven-county study area. The Forest Service has six additional areas totaling 126,345 acres which may or may not be recommended as suitable for wilderness.

Total estimated visitor days recorded by the U.S. Forest Service in 1981 on the three wilderness areas was 169,900 and is increasing. Existing use for the six additional areas under consideration is approximately 79,300 visitor days.

BLM is presently conducting wilderness studies on 29 wilderness study areas (WSAs) in the region--14 in Colorado and 15 in Wyoming. These areas total 453,758 acres of roadless public lands that may or may not be recommended to Congress for wilderness designation. Studies should be completed by 1986 for all of these WSAs.

Dinosaur National Monument has 205,898 acres which have been recommended for wilderness designation. A bill introduced into Congress in 1982 to designate most of Dinosaur Monument as wilderness was not acted upon.

Wilderness use and acres of designated wilderness have increased since 1980. Some of the most popular areas, particularly at trailheads, are at times congested during high use periods. However, the Forest Service is managing the wilderness areas to provide high quality wilderness experiences with minimum restrictions on visitor numbers and primitive activities.

None of the proposed lease areas is in or adjacent to wilderness or wilderness study areas.

LAND USE

The affected environment comprises approximately 22.9 million acres and includes Moffat, Routt, and Rio Blanco counties in Colorado and Sweetwater, Carbon, Lincoln, and Uinta counties in Wyoming. Of this region, 61.5 percent of the surface is owned and administered by the Federal government, while the remaining 32.6 percent and 5.8 percent are private and state, respectively. Table 3-21 shows a breakdown of this ownership by county. The surface estate and mineral estate of each proposed coal tract are portrayed in Chapter 2.

The land ownership pattern was developed under a number of laws and regulations, such as the Mining Law of 1872, Stockraising Homestead Act, and various railroad grants which were issued in the late 1800's and early 1900's. These railroad grants resulted in the checkerboard land ownership pattern that extends approximately 20 miles on each side of the Union Pacific railroad mainline in Wyoming. Sections alternate between private (the Union Pacific Railroad) and government (Federal or state) ownership.

The majority of the mineral estates are owned and controlled by the Federal government, while much of the surface is privately owned, resulting in a split estate. The exception to this is the mineral estate included with the checkerboard land pattern in Wyoming. The majority of these surface and mineral estates are owned by the Union Pacific Railroad. Several private surface owners of split estate lands may meet the criteria as qualified surface owners (43 CFR 3427). Coal deposits that would be mined by other than underground mining techniques will not be included in a lease sale without evidence of written consent from the qualified surface owner allowing entry and commencement of surface mining operations.

Livestock grazing is the most extensive use of the region, as the area provides year-round forage for both sheep and cattle. Grazing use differs, de-

TABLE 3-21

SURFACE OWNERSHIP BY COUNTY AND TRACT

COUNTY	Federal (acres)	Private (acres)	State ** (acres)	Total (acres)	Total Percent
Moffat	1,731,219	1,088,097	398,573	3,217,889	14.1
Routt	774,811	672,077	223,832	1,670,720	7.3
Rio Blanco	1,583,817	590,955	41,800	2,216,572	9.7
Sweetwater*	4,817,243	1,788,286	101,031	6,706,560	29.3
Carbon*	2,775,717	1,999,606	338,917	5,114,240	22.4
Lincoln*	1,884,795	573,855	157,357	2,616,007	11.4
Uinta*	<u>500,530</u>	<u>757,650</u>	<u>76,860</u>	<u>1,335,040</u>	<u>5.8</u>
TOTAL	14,068,132	7,470,528	1,338,370	22,877,028	100.0

* Figures obtained from Wyoming Resources Conservation Plan, Vol. II; Resource Conservation Accomplishments and Future Goals.

** Includes County Municipal Acres for each county.

AFFECTED ENVIRONMENT

pending on the management system used by individual ranchers. During the winter the lower elevations are utilized, where forage is more available due to less snow depth and access presents little or no problem. During the summer months, livestock are usually driven up to higher elevations, where the forage is available only during the warmer months.

Livestock operations vary in size from small ranches owned and controlled by single families to large operations managed by associations comprising a number of individuals. The types of livestock within the region include sheep, cattle, and horses. The selection of specific classes of livestock is dependent upon available water, vegetation types, topography, and personal preference.

Approximately 1.7 million animal unit months (AUM) are produced in the study region. An AUM is defined as the amount of forage required to support one cow (or equivalent) for one month. A delineation of these AUMs is provided in table 3-22 by county and tract. The majority of these AUMs within the EIS region are administered by the Federal government through grazing leases or permits and are used in conjunction with the private holdings.

There is a total of 1,113,377 acres of cropland within the region. These croplands are normally privately owned and used primarily for the production of hay and dryland wheat. Low precipitation normally limits hayland to areas along the river bottoms where irrigation water is available. Hay is the principal source of winter feed for the livestock, while wheat provides a percentage of the income for some ranching operations. Table 3-23 provides a breakdown of the major uses for the seven-county region.

The area provides a number of different habitat types that support a variety of different wildlife species. These communities range from grasslands to coniferous forests, with each contributing to the survival of certain species throughout the year (see Animal Life section).

Other land uses include coal and uranium mining, trona, recreation, oil and gas leases, and numerous types of rights-of-way, including powerlines, roads, telephone lines, railroads, and gas lines. There are also a number of special withdrawals, land exchanges, and special use permits within the region.

There are a large number of separate jurisdictional entities which exercise certain types of land and resource use controls. The authorities, responsibilities, and institutional relationships of these various Federal, state, regional, county, and municipal governments in land use planning have been described in detail in the Southcentral Wyoming Coal EIS (available for review at the BLM District Office in

Rawlins, Wyoming). Both Colorado and Wyoming have developed policies to accommodate the growth which was seen as inevitable, given the rich mineral deposits associated with each state.

Colorado established Human Settlement Policies in 1979. These provided basic guidelines for directing growth and guiding state government decisions, programs, and resource commitments. Although the state has given local governments the primary role in land use decisions, the state still maintains the power to distribute state and Federal funds to local governments.

Wyoming passed two legislative policies in 1975 to control rapid urbanization due to mineral development. The State Land Use Planning Act requires completion of county land use plans to determine if energy development proposals conflict with other land uses or community values. The Industrial Siting Act requires a prospective industry to furnish plans for alleviating socioeconomic impacts and to provide other extensive information before a state permit is granted for construction of certain facilities associated with major developments which could alter or eliminate existing land uses.

There are a number of communities that could be affected by future development. Most communities encourage coal development in their areas because it enables them to take advantage of certain benefits, such as economic gains and increased employment. However, adequate land use and community planning, good environmental reporting, and an acceptable level of restoration following land disturbing activity must occur to ensure these benefits are not offset.

ECONOMICS

Affected Environment

Economic data is available only by county. Therefore, an affected area for economic analysis has to be defined in terms of whole counties. The affected area for this analysis consists of Moffat, Rio Blanco, and Routt counties in Colorado and Carbon, Lincoln, Sweetwater, and Uinta counties in Wyoming.

Employment and Income

Employment figures in table 3-24 show the construction and mining industries separately because

TABLE 3-22
AVAILABLE AUMS/YEAR BY COUNTY AND TRACT

COUNTY	AUM's	Percent of Regional Total
Moffat	328,449	19.7
Routt	156,257	9.4
Rio Blanco	231,139	13.9
Sweetwater	434,795	26.1
Carbon	306,973	18.4
Lincoln	165,904	10.0
Uinta	40,898	2.5
TOTAL AVAILABLE	1,664,415	100.0

AVAILABLE AUMS/YEAR BY TRACT AND OWNERSHIP

TRACT	Federal	Private	State	Total	Percent of Total Tracts
Deadman	10	---	---	10	.1
Leucite Hills	150	137	---	287	2.3
Point of Rocks	138	104	32	274	2.2
Tract 98	20	---	---	20	.2
Atlantic Rim	624	765	---	1,389	11.1
Byrne Creek	48	191	9	248	2.0
Corral Canyon	79	194	---	273	2.2
Wild Horse Draw	83	84	---	167	1.3
Pio	375	---	---	375	3.0
Winton	120	290	---	410	3.3
Northeast Cow Creek	1,114	149	25	1,288	10.2
Indian Springs	151	112	---	263	2.1
Prairie Dog	1,246	---	---	1,246	9.9
Little Middle Creek	76	227	---	303	2.4
Rattlesnake Mesa	18	116	---	134	1.1
Signal Butte	23	479	---	502	4.0
Peck Gulch	52	612	---	664	5.3
Iles Mountain	87	300	---	387	3.1
Fish Creek	---	765	---	765	6.1
Bell Rock	12	177	---	187	1.5
Williams Fork Mountain	39	1,626	---	1,665	13.3
Lay Creek	265	743	80	1,088	8.7
Horse Gulch	280	294	---	574	4.6
TOTAL OF PROPOSED TRACTS	5,010	7,365	146	12,521	100.0

TABLE 3-23

EXISTING LAND USE BY COUNTY

Use Category	Moffat		Routt		Rio Blanco		Sweetwater		Carbon		Lincoln		Uinta		TOTAL	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Rangeland	2,832,202	88.0	763,324	45.7	1,697,905	76.6	6,437,793	96.0	3,818,555	74.7	2,072,479	79.2	983,935	73.7	18,606,193	81.3
Irr. Agriculture	23,300	0.8	60,600	3.6	62,000	2.8	32,103	0.5	315,314	6.2	92,127	3.5	97,014	7.3	682,458	3.0
Nonirr. Agriculture	100,928	3.1	79,750	4.8	24,000	1.1	73,484	1.1	102,105	2.0	47,302	1.8	3,350	0.2	430,919	1.9
Woodlands	55,760	1.7	735,118	44.0	381,460	17.2	10,648	0.2	683,938	13.4	353,781	13.5	60,580	4.5	2,281,285	10.0
Urban & build-up	32,606	1.0	23,100	1.4	15,511	0.7	15,522	0.2	84,328	1.6	31,318	1.2	81,078	6.1	283,463	1.2
Other*	173,093	5.4	8,828	0.5	35,696	1.6	137,010	2.0	110,000	2.1	19,000	0.8	109,083	8.2	592,710	2.6
TOTAL	3,217,889	100.0	1,670,720	100.0	2,216,572	100.0	6,706,560	100.0	5,114,240	100.0	2,616,007	100.0	1,335,040	100.0	22,877,028	100.0

SOURCE: District Soil Conservation Offices located within each county in Colorado, and Wyoming Resources and Conservation Plans, Vol. II; Resource Conservation Accomplishments and Future Goals.

* Includes national parks, recreation areas, wildlife refuges for Colorado, and rights-of-way and industries for Wyoming.

AFFECTED ENVIRONMENT

these are where the primary impacts would occur. Secondary impacts would be scattered over a number of other industries.

Colorado employment and income figures in table 3-24 are by place of residence. For this reason, they will differ from most other employment and income figures, which are by place of work and do not take commuting into account. The residence adjustment estimates are not available for Wyoming, so Wyoming figures are by place of work.

The economies of six of the seven counties in the affected area are based on mining and agriculture. The seventh county--Routt--has skiing as its central activity, but mining and agriculture are also important. Minerals vary in significance by county. Coal is the leading mineral in Moffat, Routt, and Carbon counties. Oil and gas are primary in Rio Blanco County and the Overthrust Belt area of Lincoln and Uinta counties. (Lincoln County also has significant coal production.) Trona (soda ash), oil and gas, and coal are all important in Sweetwater County. Uranium was a major product in Carbon County but has slumped because of market conditions.

Mineral related industries are important in all of the counties. There are coal-fired electric power plants in Moffat, Routt, Lincoln, and Sweetwater counties. Carbon County has an oil refinery, and Uinta County has natural gas sweetening plants. Rio Blanco and Uinta counties have oil and gas field service activities.

Agriculture, primarily livestock production, remains an important industry in all seven counties but has become small numerically compared to the other developments. Lincoln County also has a dairy products industry.

Principal centers of tourist recreation are Steamboat Springs in Routt County and Flaming Gorge Reservoir, which is partially in Sweetwater County. Summer tourist activity occurs in the mountains of Rio Blanco, Routt, and Carbon counties, while hunting draws outside recreationists to all of the counties.

The Union Pacific Railroad continues to be a major employer in Carbon, Sweetwater, and Uinta counties. Other sectors of the economic base include sawmills, the state mental hospital in Uinta County, and the state penitentiary in Carbon County.

Population

Uneven settlement characterizes the affected area. Most of the communities listed in table 3-25

are located along the White, Yampa, Green, and Hams Fork river valleys and the Union Pacific Railroad. Areas between these population and transportation corridors consist of sparsely settled ranching country and unpopulated national forest and BLM lands.

The larger towns serve as local trade and business centers. Regional trade, business, and manufacturing activities are located in larger centers--Denver, Salt Lake City, Grand Junction, and Cheyenne--outside the impacted area.

Housing

The status of housing (occupied, vacant, and mobile homes) is portrayed in table 3-26. Data on mobile homes in Colorado was not readily available and is thus not included in the table. However, since most of the Colorado communities are not currently in a boom condition, it can be surmised that the proportion of mobile homes to total housing is probably somewhat lower in Colorado than in Wyoming.

Vacancy rates were less than 10 percent (indicative of a housing shortage) in about half of the communities. Housing remains scarce and expensive in Rangely, Diamondville, Evanston, Lyman, and Mountain View, as well as in Dinosaur, Baggs, and Kemmerer (where vacancy rates were above 10 percent). These communities are currently being impacted by coal and oil and gas development. Housing has become more available since 1980 in Hayden, Rawlins, Green River, and Rock Springs as reduced population growth or actual decline has allowed construction to catch up with demand. Vacancy levels in table 3-26 should be treated with caution because the housing situation in many communities has changed in the ensuing three years and because vacancy levels do not indicate either physical condition or whether housing units are year-round versus seasonal units.

Affected Industries

Agriculture

Livestock production is the principal agricultural activity. Crop production is dominated by hay for livestock use. Estimated 1980 livestock and crop earnings are shown in table 3-27.

TABLE 3-24
1980 EMPLOYMENT AND INCOME

	Employment				Total Labor Income (000)
	Construction	Mining	All Other	Total	
Colorado					
Moffat County					
Amount	559	1,076	4,837	6,472	\$ 99,971
Percent of Total	9	16	75	100	
Rio Blanco County					
Amount	1,097	1,563	2,128	4,788	92,557
Percent of Total	23	33	44	100	
Routt County					
Amount	1,060	608	5,942	7,610	99,909
Percent of Total	14	8	78	100	
Wyoming					
Carbon County					
Amount	909	3,066	8,652	12,627	252,847
Percent of Total	7	24	69	100	
Sweetwater County					
Amount	2,898	7,127	12,407	22,432	407,011
Percent of Total	13	32	55	100	
Uinta County					
Amount	470	1,137	4,187	5,794	76,650
Percent of Total	8	20	72	100	

NOTE: Colorado figures are by estimated place of residence, but Wyoming figures are by place of work. The estimated adjustment for residence is not available for Wyoming. Lincoln County is excluded because it contains only maintenance tracts.

TABLE 3-25
1980 POPULATION

Colorado		
Moffat County	13,133	
Craig		10,239
Dinosaur		312
Maybell*		240
Rio Blanco County	6,255	
Meeker		2,369
Rangely		2,126
Routt County	13,404	
Hayden		1,647
Milner*		150
Oak Creek		890
Phippsburg*		200
Steamboat Springs		6,480
Yampa		450
Wyoming		
Carbon County	21,896	
Baggs - Dixon		515
Rawlins		11,547
Other		9,834
Lincoln County	12,177	
Diamondville		1,000
Kemmerer		3,273
Sweetwater County	41,723	
Green River		12,807
Point of Rocks **		210
Rock Springs		19,454
South Superior		586
Uinta County	13,021	
Evanston		6,421
Lyman		2,284
Mountain View		628

SOURCE: U.S. Department of Commerce, 1980 Census of Population and Housing; BLM estimates.

* BLM estimates

** Sweetwater County Association of Governments, 1981, Sweetwater County Housing Plan, Sweetwater County, Wyoming.

TABLE 3-26
1980 HOUSING UNITS

	Occupied	Vacant	Mobile Homes
Colorado			
Craig	2,947	340	
Dinosaur	105	28	
Meeker	846	135	
Rangely	684	59	
Hayden	577	33	
Oak Creek	370	148	
Steamboat Springs	2,051	1,430	
Yampa	159	49	
Wyoming			
Baggs	155	26	97
Dixon	35	11	11
Rawlins	3,892	324	642
Diamondville	337	20	178
Kemmerer	1,152	147	213
Green River	3,980	253	825
Rock Springs	7,031	469	1,533
South Superior	206	38	45
Evanston	2,151	154	471
Lyman	664	61	377
Mountain View	206	13	68

SOURCE: U.S. Department of Commerce, 1980 Census of Population and Housing.

NOTE: Data not available for Maybell, Milner, Phippsburg, and Point of Rocks. Data on mobile homes not obtained for Colorado.

TABLE 3-27
1980 AGRICULTURAL EARNINGS
(thousand dollars)

County	Livestock and Products	Crops	Total
Colorado			
Moffat	\$10,491	\$2,891	\$13,382
Rio Blanco	7,778	914	8,692
Routt	10,015	3,796	13,811
Wyoming			
Carbon	38,942	1,311	40,253
Lincoln	15,712	1,851	17,563
Sweetwater	7,506	328	7,834
Uinta	9,537	611	10,148

SOURCE: Bureau of Economic Analysis, Regional Economic Information System, 1982. BEA Farm Income and Expenditures. U.S. Department of Commerce, Washington.

AFFECTED ENVIRONMENT

Mining

Coal production is a significant mineral activity in five of the seven counties (all except Rio Blanco and Uinta). In 1980, a total of 40.3 million tons was produced in the impacted area, 27.5 million tons coming from three of the four Wyoming counties (none in Uinta) and 12.8 million tons from the three Colorado counties. Colorado coal production was valued at \$259 million and Wyoming production at \$550 million.

Recreation

Hunting is the only economically significant recreation activity on the tracts. In 1981, an estimated total of 395,000 days were spent by hunters in the three Colorado counties, while, in 1980, 274,000 days were spent in three of the four Wyoming counties (all except Lincoln), which is where wildlife impacts might occur. Total (statewide) expenditures for this hunting activity are estimated at \$43 million in Colorado and \$15 million in Wyoming.

Local Government Finances

Communities usually obtain most of their revenues locally. Previous studies in this region have shown that local sources account for 65 to 95 percent of total community revenues. This large dependence on local sources means that the communities can be highly impacted by developments that affect their tax base. Regional school districts usually are less dependent on locally generated revenues because of state equalization formulas.

Rough measures of local funding sources are provided by the per capita figures on assessed valuation and sales taxes in table 3-28. They show that, in general, the larger communities have more substantial property and sales tax bases, but that these and school district tax bases vary considerably. Those communities and school districts which have strong tax bases, generally because they are either business, mining, or tourist centers, are in a better position to handle financial impacts.

At present, Colorado communities' ability to increase these revenue sources is somewhat restricted. Colorado state law imposes a seven percent limit on annual increases in property tax revenues and a four percent ceiling on combined municipal and county sales tax rates. However, Moffat and Rio Blanco counties presently have only two percent sales tax rates, while Routt County has no sales tax at all. Therefore, communities in these counties have some leeway to raise revenues.

In Wyoming, maximum limits are imposed on community mill levies, and sales taxes in all counties are at the maximum rate permitted. School district property tax revenues in both states are controlled by the state equalization formulas.

Figures on remaining bonding capacity in table 3-28 show the amount of major capital improvement that could be funded from local resources. State laws impose the ceilings shown in the footnotes. Most of the communities, and all but one of the school districts, have more than half of their bonding capacity still available for use. However, major growth would impose capital improvement requirements in excess of most communities' local resources.

SOCIAL ENVIRONMENT

Introduction

The existing social conditions for most of the study region reflect some influences of current or recent "energy boom" experiences. In order, therefore, to describe adequately the present social environments of the communities of the region, it is first necessary to outline briefly the components and general processes of boom growth and decline that each community reflects in its social readiness for growth.

Among initial factors affecting the nature, severity, and duration of social effects of energy development on any community are the following:

Local history

Community size

Social power mix

Adequacy of physical facilities & housing

Adequacy of social services delivery

Local value systems

Cultural diversity of population

Type of community integration

Map 3-5 shows locations of the communities that would be affected by the proposed leasing, along with their relationships to each other and to the various tracts and associated roads. In Wyoming the towns (and tracts) are primarily spread along I-80; in Colorado, along U.S. 40. Craig, Colorado, and Rawlins and Rock Springs, Wyoming, are the major population and trade centers of the region.

TABLE 3-28

LOCAL GOVERNMENT FINANCIAL DATA

	Craig	Dinosaur	Meeker	Rangely	Hayden	Oak Creek	Steamboat Springs	Yampa
Assessed valuation (1/1/82)								
Total (000)	\$28,109	\$428	\$7,008	\$8,405	\$4,462	\$1,716	\$58,755	\$1,096
Estimated per capita	2,540	670	2,690	3,280	2,310	1,550	8,400	2,110
Mill levy (1/1/82)	12.00	13.222	8.83	18.94	23.018	20.00	0	15.00
Sales taxes (1980)								
Total (000)	\$ 1,195	\$ 10	\$ 138	\$ 103	\$ 98	\$ 41	\$ 3,521	\$ 0
Estimated per capita	120	30	60	50	60	50	540	0
Sales tax rate (7/1/81) (%)	2.0 **	2.0 **	2.0 **	2.0 **	2.0	3.0	4.0	0
Bonded debt (12/31/80) (000)								
General obligation	\$ 7,015	\$ 0	\$ 0	\$ 221	\$ 821	\$ 170	\$ 4,170	\$ 0
Revenue	60	0	1,347	666	591	0	330	199
Remaining bonding capacity (000) *	**	43	701	619	0	2	**	110
	Baggs	Dixon	Rawlins	Diamondville	Kemmerer	Green River	Rock Springs	South Superior
Assessed valuation (1/1/82)								
Total (000)	\$ 732	\$ 115	\$21,390	\$1,562	\$6,380	\$23,047	\$45,057	\$ 367
Estimated per capita	1,720	1,390	1,910	1,170	1,580	1,770	2,280	630
Mill levy (1/1/82)	8.00	8.00	11.00	8.00	13.80	7.00	1.00	46.88
Sales taxes (1980)								
Total (000)	45	\$ 19	\$ 2,198	\$ 72	\$ 318	\$ 2,274	\$ 5,777	\$ 106
Estimated per capita	\$ 100	230	190	70	100	180	300	180
Sales tax rate (7/1/81) (%)	2.0 †	2.0 †	2.0 †	2.0 †	2.0 †	2.0 †	2.0 †	2.0 †
Bonded debt (12/31/80) (000)								
General obligation	\$ 0 ††	\$ 100 ††	\$ 3,253 ††	\$ 0 ††	\$ 229 ††	\$ 725 ††	\$ 0 ††	\$ 0 ††
Revenue	16 ††	30 ††	0 ††	0 ††	0 ††	0 ††	0 ††	0 ††
Remaining bonding capacity (000) *	13	0	0	62	26	1,119	1,802	15

SOURCES: Colorado Division of Property Taxation, Eleventh Annual Report
Colorado Division of Local Government, 1980 Local Government Financial Compendium, and files
Colorado Department of Revenue, Annual Report 1981
Wyoming Taxpayers Association, Wyoming Property Tax Rates 1982
Wyoming Department of Revenue and Taxation, Annual Report 1981
Dain Bosworth, Inc., Financial Facts on Wyoming Taxing Units, 1980 edition
Data from local governments

NOTE: Maybell, Milner, Philippsburg, and Point of Rocks are unincorporated and have no tax base.

* Percentage of assessed valuation, less general obligation bonded debt. Percents are:
Colorado: Community: 10% (30% of actual valuation which, at 30% assessment rate, equals 10% of assessed valuation)
School Districts: 20%
Wyoming: Communities: 4%, plus an additional 4% for sewer bonds
School Districts: 10%

† One-third of 3% state sales tax plus 1% optional tax. Distributed according to population.
†† 6/30/80.

LOCAL GOVERNMENT FINANCIAL DATA

	Evanston	Lyman	Mountain View	Mof fat County School Dist.	Meeker School District	Rangely School District	Hayden School District	Steamboat Springs School Dist.
Assessed valuation (1/1/82)								
Total (000)	\$18,206	\$2,472	\$1,173	\$288,703	\$34,006	\$300,786	\$59,028	\$87,413
Estimated per capita	2,280	950	1,640	20,080	9,000	93,940	19,350	9,550
Mill levy (1/1/82)	7.963	10.821	8.00	25.91	51.08	9.19	27.05	45.703
Sales taxes (FY 1981)								
Total (000)	1,357	548	161					
Estimated per capita	210	240	260					
Sales tax rate (7/1/81) (%)	2.0 †	2.0 †	2.0 †					
Bonded debt (12/31/80) (000)								
General obligation	334 ††	81 ††	0 ††	7,470	830	0	1,740	8,440
Revenue	0 ††	0 ††	0 ††					
Remaining bonding capacity (000) *	1,122	18	47	50,271	5,971	60,157	10,066	9,043
	South Routt School Dist.	Rawlins School District	Kemmerer School District	Rock Springs School Dist.	Green River School Dist.	Evanston School District	Mountain View School Dist.	Lyman School District
Assessed valuation (1/1/82)								
Total (000)	\$36,614	\$391,515	\$169,886	\$672,506	\$458,140	\$381,937	\$12,448	\$34,524
Estimated per capita	13,860	30,590	33,310	25,970	27,770	46,020	4,020	8,220
Mill levy (1/1/82)	41.83	45.96	58.563	46.21	48.63	52.578	59.157	52.493
Sales taxes (FY 1981)								
Total (000)								
Estimated per capita								
Sales tax rate (7/1/81) (%)								
Bonded debt (12/31/80) (000)								
General obligation	0 *	8,265 ††	2,860 ††	17,329 ††	13,680 ††	1,140 ††	713 ††	243 ††
Revenue								
Remaining bonding capacity (000) *	7,323 *	30,887	14,129	49,922	32,134	37,054	532	3,209

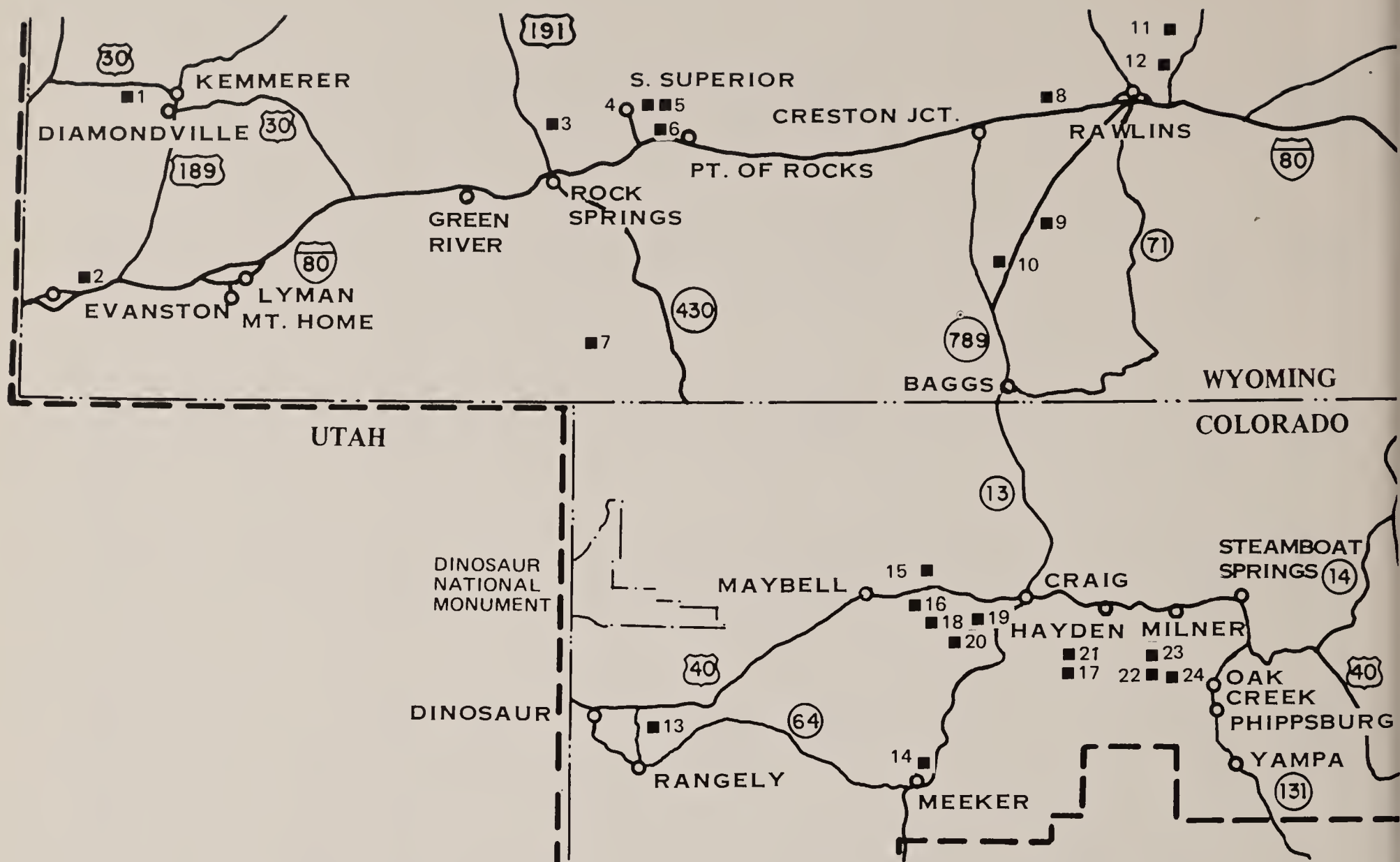
SOURCES: Colorado Division of Property Taxation, Eleventh Annual Report
 Colorado Division of Local Government, 1980 Local Government Financial Compendium, and files
 Colorado Department of Revenue, Annual Report 1981
 Wyoming Taxpayers Association, Wyoming Property Tax Rates 1982
 Wyoming Department of Revenue and Taxation, Annual Report 1981
 Dain Bosworth, Inc., Financial Facts on Wyoming Taxing Units, 1980 edition
 Data from local governments

NOTE: Maybell, Milner, Philpsburg, and Point of Rocks are unincorporated and have no tax base.

* Percentage of assessed valuation, less general obligation bonded debt. Percents are:
 Colorado: Community: 10% (30% of actual valuation which, at 30% assessment rate, equals 10% of assessed valuation)
 School Districts: 20%
 Wyoming: Communities: 4%, plus an additional 4% for sewer bonds
 School Districts: 10%

†† 6/30/80.

* South Routt School District has recently sold a \$2.5 million bond issue.



■ PROPOSED COAL LEASE TRACTS

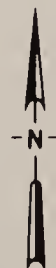
WYOMING

TRACT 98	1
BYRNE CREEK	2
WINTON	3
LEUCITE HILLS	4
DEADMAN	5
POINT OF ROCKS	6
PIO	7
INDIAN SPRINGS	8
ATLANTIC RIM	9
NE COW CREEK	10
CORRAL CANYON	11
WILD HORSE DRAW	12

COLORADO

PRAIRIE DOG	13
RATTLESNAKE	14
LAY CREEK	15
SIGNAL BUTTE	16
PECK GULCH	17
HORSE GULCH	18
BELL ROCK	19
ILES MOUNTAIN	20
WILLIAMS FORK	21
LITTLE MIDDLE CREEK	22
FISH CREEK	23
MIDDLE CREEK	24

0 100 MILES



Map 3-5. Relationships of Towns, Tracts, and Highways

AFFECTED ENVIRONMENT

Boom Town Population Growth and Decline

The factors listed above influence the nature of social impacts on given communities. These are acted upon, however, by employment patterns (and thus by population growth patterns) that are similar from one project to another. The "typical boom town" goes through a sequence of problems and change processes, depending upon how its "readiness" interacts with the following:

Type of resource involved (determines employment sequences and proportions of types of workers)

Cultural similarity between residents and in-migrants

Construction worker transiency and turnover

This section will consider the general form of employment sequences for coal development. A model of the social change processes which in general define a "boom town" is dealt with next. Finally, a description of the present social characteristics of the communities expected to be affected and their readiness to absorb energy growth is presented. The first two of these are necessary to an understanding of the third, and all three elements are needed to clarify the nature of actual social impacts that would result from the leasing alternatives, as described in Chapter 4.

The typical employment pattern for coal mines consists of a three-pronged influx with various exits, a model of which is shown in figure 3-4. Construction workers enter in large numbers over a short time, followed later by operations personnel (administrators and staff first, miners later). These population increases, in turn, draw a secondary, or nonbasic, population of salespeople, waitresses, teachers, equipment dealers, social workers, and others.

Construction requires many specialized blue collar skills (carpenters, electricians, pipe fitters, plumbers, etc.) temporarily. As various stages start and finish, transiency causes fluctuations in the population curve (wavy line in the figure), with accompanying social disruption in the community.

A "boom" period (described in the next section) is shown in the model as the shaded lag time between a large influx of construction workers plus early operations workers, and the time when nonbasic employment is able to catch up so that services and facilities become adequate. In actuality, unless the town is prepared ahead of time, such things as housing, water and sewer systems, streets, schools, and other physical needs may lag even further, with corresponding social lags. The nonbasic workers are themselves, of course, part of the growth impact.

Some of the nonbasic workers are also temporary; their numbers decline with the end of construction. However, many of these are probably drawn from the local labor pool and do not necessarily represent a large influx or exodus.

It is generally agreed by experts that boom conditions will begin to appear if an annual growth rate is too great. The level of "too great" is not agreed upon, ranging from 5 to 15 percent annually. This lack of consistency may be due to the fact that the precise degree and nature of impacts will vary, depending on the factors noted earlier.

Some social problems are created because long-time residents tend to develop negative stereotypes, particularly of construction workers. Local perceptions and the behavior they induce are usually more negative than real cultural differences or degree of transiency would justify. Data are insufficient to be certain, but the best evidence indicates that most construction workers are from within the region itself and are not very different (Mountain West Research 1975; see also discussion in Green River-Hams Fork Round I Final EIS, p. 108). They apparently remain as long as possible, especially if married, going from job to job in the area, sometimes commuting some distance in order to prolong residency in one spot. Some differences, however, are socially important. Construction workers do tend to be younger, are more often transient and single, and usually come on the scene before a community is able or willing to receive them. They place somewhat different demands upon the community than will more settled, older workers because they have fewer ties and less commitment to the area. They are often lonely, without local social bonds, so are more apt to frequent the bars in their spare time to find companionship.

Some communities may react to young construction workers by trying to close ranks to exclude them in much the same way and using the same rationale that towns near military bases may try to shut out a large influx of young recruits. These construction workers pose little threat to, and do not even affect, most community social structures but are likely to be perceived as threats to the safety and stability of the community because of the negative stereotypes.

Most operations workers are also blue collar, but their social impacts are different. High wages, permanency, and the usual presence of families provide more ways for these workers to become a part of the community. They arrive after some social and economic adjustments have been made, are less conspicuous, and therefore seem less threatening. They affect such social institutions as schools, churches, and civic and government organizations.

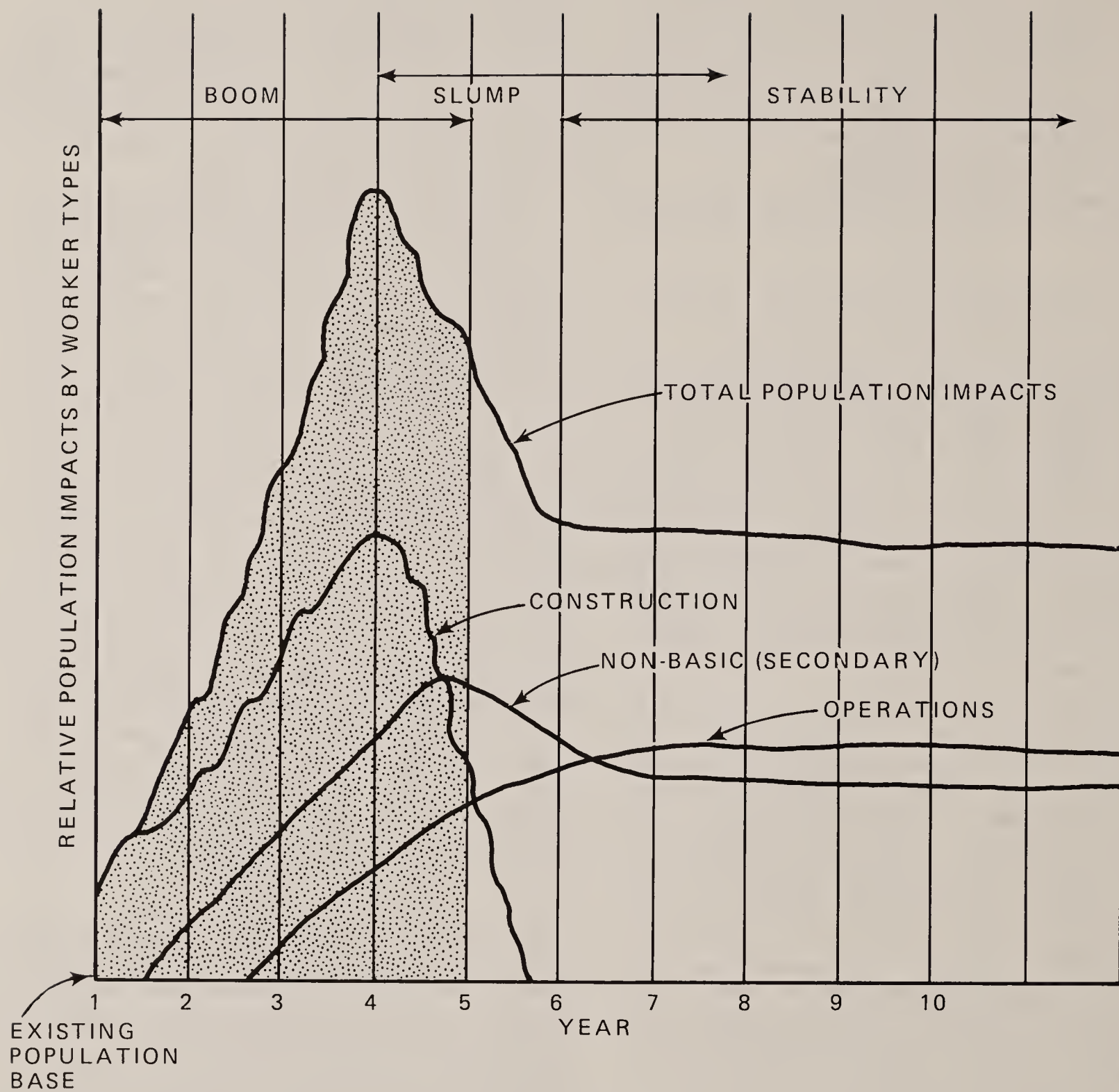


Figure 3-4. Model of Population Impacts on a Community from Coal Development

AFFECTED ENVIRONMENT

Salespeople, teachers, and other secondary workers generally differ little, if at all, from the existing population.

For coal development, the boom will typically close with some slump in population (year 4 and 5 in figure 3-4), requiring downward adjustments in services, housing, etc., followed finally by a new stabilization at a larger population than the original but smaller than the peak (years 6 and following in the figure). With full production, social structural and social psychological changes will also slow to an acceptable, comfortable pace because of population leveling. Of course, if the population is growing from other sources as well--a rising baseline--the slump and stabilization may not take place.

Boom Town Social Change

A growing literature exists, of varying quality and with some contradictions, describing the social impacts on an unprepared small town subjected to the sudden onslaught of major energy projects. Table 3-29 summarizes what is presently understood about changes in social elements such as social structures, at-risk groups, attitudes, and other elements.

Taken together, the components of this table represent a model social portrait of a boom town. For instance, the fourth element of Part A, "Control and Safety," shows that the structure of law enforcement, which is primarily charged with this responsibility, will undergo formalization (better equipment, more impersonal procedures, and more professionally trained personnel will replace less scientific equipment, informal procedures, and less trained personnel). The influence of the police and sheriff departments in the community will increase. At first, need will outstrip supply of personnel and equipment (short-term negative), but, in the long run, law enforcement services will have improved because of the changes (long-term positive). During the transition the community will define social control and safety as a problem (high crime rates, locking doors, fears at night).

The interested reader is urged to consider each element line of the model summarized by table 3-29 for its implications in order to track boom town change processes.

Affected Communities and their Readiness

All of the communities expected to be affected by the proposed leasing, except Maybell, have felt impacts from energy development in the past dozen years to some degree or other. Some are currently in boom situations. (Maybell expected

energy development impacts and has been on their fringes.)

Table 3-30 summarizes each community's background and present readiness to absorb new growth. Obviously, a very small community and a larger town with equally good readiness will be able to absorb quite different numbers of persons. The table shows that the earlier histories of some, but not all, towns continue to affect their present ability to accommodate new growth (column 9).

A number of towns have only recently completed a boom cycle, while others are currently in the midst of boom conditions. With the exception of Evanston, the larger towns--Craig, Steamboat Springs, Rawlins, Rock Springs, and Green River--generally have a good ability to absorb new growth. They have recently passed through severe booms, followed by a time of catching up during which growth pressures eased and citizens had time to adjust to new social structural systems, modified norms, diversification of power, and other changes.

The very small towns, whose social integration is based upon informality, are highly vulnerable to social disruptions unless the community's attitudes are very positive toward growth and growth rates are kept slow.

In general, no community in the study region today should be caught off guard by new coal leasing. They are all familiar with boom processes, and most have experienced them. A town's ability to prepare in advance for growth may be constrained by a lack of funds and (even more so) by a lack of accurate growth estimates toward which to direct preparations. Industry projections of labor needs, projected scheduling of projects in a given area, and even what projects may in fact go at all, are impossible to specify adequately. But simple community awareness of what is involved, based on what has taken place before, is in itself one important element in *social* preparation for change.

TRANSPORTATION

Major transportation corridors in the area are U.S. 40 and the Denver and Rio Grande Western Railroad in Colorado and I-80 and the Union Pacific Railroad in Wyoming. Map 3-6 shows all of the affected roads in the study region. It also shows these roads broken out by road segment (A, B, C, etc.).

TABLE 3-29
SOCIAL IMPACTS: PORTRAIT OF A BOOMTOWN*

		Power/ Influence	Personnel/Facilities		Defined *** as Social Problem
A. Social Structure	Formalization		Short Term	Long Term	
Political	Occurs **	Longtimers - Newcomers +	-	+	
Economic	Occurs	Longtimers - Newcomers +	-	+	
Educational	Occurs	N/A	-	+	
Control/Safety	Occurs	+	-	+	Yes
Religious	Occurs	-	-	+	
Recreational	Occurs	N/A	-	+	Yes
Health-Physical	Occurs	+	-	+	Yes
Health-Mental	Occurs	+	-	+	Yes
Social Services	Occurs	+	-	+	Yes

		Well Being			Interaction Opportunities	Economic Opportunities	Defined as Social Problem
B. Social Groups	Power	Physical	Economic	Psychological			
Elderly	-	+	+ -	+ -	+ -	N/A	Yes
Youth	N/A	+ -	+	+ -	+	+	Yes
Women							
Short term	-	+ -	+ -	-	+ -	+ -	Yes
Long term	+	+ -	+ -	-	+ -	+	
Men	+	+	+	+ -	+	+	
Ranchers	-	0	+ -	+ -	+ -	+ -	

C. Social/Physical Conditions	Short Term	Long Term	Defined as Social Problem
Housing	-	0.	(short term) Yes
Noise/Dirt	-	+ -	Yes
Traffic	-	-	Yes
Unemployment	+ (would decrease)	+ -	
Living Costs	+ -	+ -	(short term) Yes
Quality of Life	+ - 0	+ - 0	

D. Attitudes/Values	Short Term	Long Term
Energy	+ -	+ 0
BLM	+ -	+ -
Local Traditions	-	-
"World View"	+	+
Liberalism	+	+
Community Changes	-	+ -

* This table is an attempt to summarize existing literature on what happens to a town in an energy boom. Literature referenced includes Albrecht (n.d.); Bates (1978); Cortese (1979); Cortese & Jones (1977); Freudenburg; (all items in Biblio); Gilmore (all items in Biblio); Jobes (1976); Kassover & McKeown (n.d.); Lantz & McKeown (1979); Lillydahl et al (1982); Margolis (n.d.); Moen et al (1979); Moen (1983); Wilkinson (1982); Weise (1979); and especially Pacific Sociological Review (July 1982).

** See text for explanation.

*** A social situation only becomes a "social problem" when society identifies it as such. There is public recognition of a need for solutions to these problems but not necessarily agreement on what solutions should be.

+ Positive Impact - Negative Impact 0 No Change N/A Not Applicable

+ - Positive for some persons/groups, or under some conditions; negative for other persons/groups, or under some other condition.

TABLE 3-30

SOCIAL COMPONENTS AND READINESS FOR ADDITIONAL GROWTH: STUDY AREA COMMUNITIES

Column 1	2	3	4	5	6	7	8	9
Community	1980 Popu- lation	Important Historical Factors	Recent Energy Impacts (1970 - Present)	Present Social Condition	Local Values	Social Power	Community Integra- tion	Present Ability To Absorb Growth
<u>COLORADO:</u>								
Craig	10,239	Isolated ranching center; harsh climate; old west flavor; self-sufficient, ranchers dominant power	Craig Powerplant, Units 1, 2, 3 Coal Boom over 1981	Stable; caught up on most facilities and services; many outside linkages; formalized social services and controls; adequate housing	Mixed, New on old	Mixed	Urban	Excellent
Maybell (Unincorporated)	240	Not relevant	A few residents changed from ranching and small business to energy work in Craig. In shadow of stalled Cross Mountain Dam project	Slow growth as bedroom for Craig; expanding sewer and water; volunteer services, informal planning; some hunting and pass-through tourism	Con- serva- tive	Ranchers	Close Informal	Fair
Dinosaur	312 (1983: near 1,000)	Not relevant	Western Fuels Coal Mine and electric train construction Boom in progress	In midst of boom; many trailers; town struggling to keep up with new facilities needs; will slow somewhat when construction completed	Mixed	Undiffer- entiated	Close Informal Changing	Poor
Rangely	2,126 (1983: about 3,400)	Very isolated; always an energy town; old oil and gas becoming depleted but still important; oriented to Vernal, Utah	Western Fuels Coal Mine and electric train construction Boom in progress	In midst of boom; housing shortages; excellent mitigation monies from Western Fuels; expansion from recent purchase of BLM land; reluctance to accept transients; may slow somewhat when mine operational	Con- serva- tive Liber- aliz- ing	Energy, Diversify- ing	Formal- izing	Poor

TABLE 3-30
(Continued)

SOCIAL COMPONENTS AND READINESS FOR ADDITIONAL GROWTH: STUDY AREA COMMUNITIES

Column 1	2	3	4	5	6	7	8	9
Community	1980 Popu- lation	Important Historical Factors	Recent Energy Impacts (1970 - Present)	Present Social Condition	Local Values	Social Power	Community Integra- tion	Present Ability To Absorb Growth
Meeker	2,369	Isolated, domin- ance of ranching; hunting and fish- ing tourism	Ca and Cb oil shale Coal Boom over 1981	Town in slump; uncertainty of future of oil shale and coal; conflict with Bar 70 Enterprises over land, water, development control.	Con- serva- tive, Liber- aliz- ing	Ranchers, Energy; Diversify- ing	Formal- izing	Good
Steamboat Springs	6,480 (1983: about 7,800)	Most growth tour- ist related (ski- ing, fishing, hunting) Ranching, coal	Coal, but most impacts from growth of ski industry	Continuing ski growth Coal slowdown; many out- side linkages; large pro- portion young transients.	More liber- al than gener- al region	Ski owners, business; Ranching on wane	Urban	Good
Hayden	1,647	Ranching, coal	Hayden Powerplant, Units 1 & 2 Coal Boom over 1981	Stable; some persons work in Craig; coal slowdown; oriented to both Craig and Steamboat Springs	Con- serva- tive, Liber- aliz- ing	Mixed	Some Formal- ization	Good
Oak Creek	890	Coal Bedroom for Steam- boat service work- ers	Coal growth Minor boom over 1982	Stable-to-slump Coal mines reaching depletion	Con- serva- tive	Mixed Stable	Mostly Informal	Fair (may be- come good if mines not re- newed)

TABLE 3-30
(Continued)

SOCIAL COMPONENTS AND READINESS FOR ADDITIONAL GROWTH: STUDY AREA COMMUNITIES

Column 1	2	3	4	5	6	7	8	9
Community	1980 Popu- lation	Important Historical Factors	Recent Energy Impacts (1970 - Present)	Present Social Condition	Local Values	Social Power	Community Integra- tion	Present Ability To Absorb Growth
Yampa	450	Hunting and fish- ing tourism Ranching Some persons work in Phippsburg railroad yards	Coal growth No boom	Slump from coal slowdown USFS expansion Tightly knit	Con- serva- tive	Undiffer- entiated	Close Informal	Good
Phippsburg (Unincorporated)	200	Railroad shops	Coal growth No boom	Tightly knit, stable; strong internal cohesion	Con- serva- tive	Undiffer- entiated	Close Informal	Poor
Milner (Unincorporated)	150	Not relevant	Coal growth No boom	Some growth; bedroom for Steamboat service workers and Hayden plant	Con- serva- tive	Undiffer- entiated	Informal	Poor
<u>WYOMING:</u>								
Rawlins	11,547	Ranching; old west flavor; transpor- tation center; coal, oil and gas; hunting and fish- ing, jade and other rock hound- ing tourism	Coal, oil and gas, uranium Boom over 1980-1981	Decline, caught up on most facilities and ser- vices; many outside link- ages; formalized social services and controls; surplus housing, 15% mobile homes	Mixed, Some new on old, still large- ly con- serva- tive	Mixed	Urban	Excellent
Baggs	515 (Baggs Dixon)	Ranching, coal, oil and gas, tran- sieney; decline before 1970	Oil and gas Population fluctuation	Considerable transieney (oil and gas); 54% mobile homes 1980; core of old- timers	Con- serva- tive	Ranchers, but mostly undifferen- tiated; changing	Informal Changing	Poor

TABLE 3-30

(Continued)

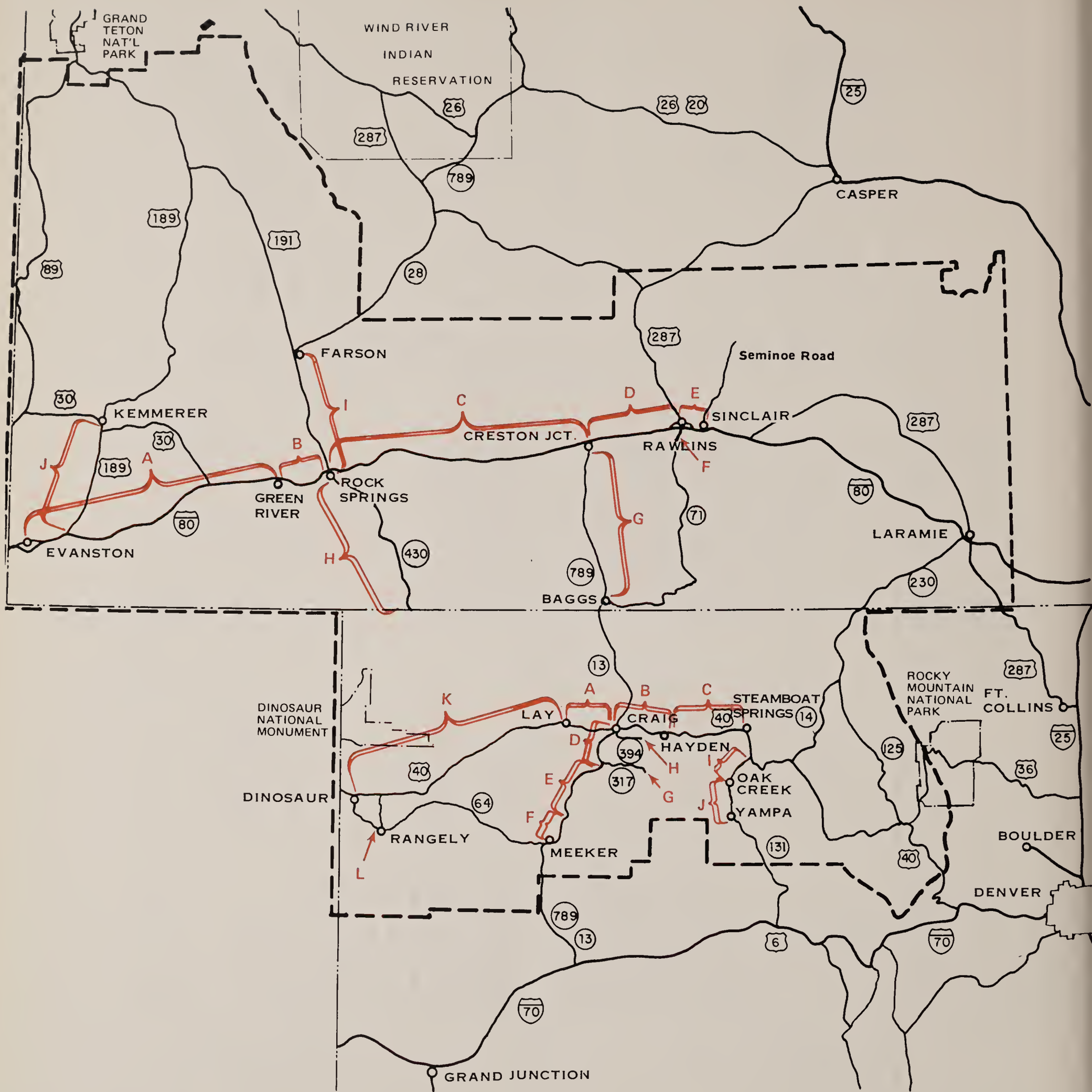
SOCIAL COMPONENTS AND READINESS FOR ADDITIONAL GROWTH: STUDY AREA COMMUNITIES

Column 1	2	3	4	5	6	7	8	9
Community	1980 Popu- lation	Important Historical Factors	Recent Energy Impacts (1970 - Present)	Present Social Condition	Local Values	Social Power	Community Integra- tion	Present Ability To Absorb Growth
Point of Rocks (Unincorporated)	210	Not relevant	Bridger Powerplant and coal mines (1-80 entrance) Boom ending	Trailer village; no ser- vices or facilities except truck stop; many single transients	Not inter- grated	Not inte- grated	Poor, Informal	Very poor
South Superior	586	Originally rail- road coal Deep decline until 1970's	Bridger Powerplant and coal mines Boom ending	Rejuvenation of town; some new homes, 18% mobile homes 1980; want growth	Con- serva- tive	Undiffer- entiated	Close, Informal	Fair
Rock Springs	19,454	Originally rail- road coal; many non-English speak- ing miners so pre- sent high ethnic diversity Decline when rail- road changed to diesel	Bridger Powerplant and coal mines; trona mines; much negative natural media atten- tion in 1970's because of boom; serious hous- ing problems Boom over	Recent decline; cultural diversity; much new hous- ing; "cleaned up" law enforcement; town beauti- fication; caught up on services and facilities; formalized services and controls; many outside linkages; 20% mobile homes 1980. Possible restraints on expansion due to sur- rounding public lands.	Di- verse	Mixed	Urban	Good
Green River	12,807	Original major railroad center for passengers, freight, fueling and workers; coal mining shift to trona; center for construction of Flaming Gorge; John Wesley Powell take-off point	Trona Boom over	Decline but still impor- tant railroad center; tourism; much new housing; many outside linkages; 19% mobile homes 1980. Possi- ble restraints on expan- sion due to surrounding public lands.	Di- verse	Mixed	Urban	Good

TABLE 3-30
(Continued)

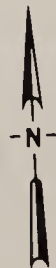
SOCIAL COMPONENTS AND READINESS FOR ADDITIONAL GROWTH: STUDY AREA COMMUNITIES

Column 1	2	3	4	5	6	7	8	9
Community	1980 Popu- lation	Important Historical Factors	Recent Energy Impacts (1970 - Present)	Present Social Condition	Local Values	Social Power	Community Integra- tion	Present Ability To Absorb Growth
Kemmerer	3,273	Isolated; on Over-	Overthrust Belt oil	Rapid growth, some facili-	Con-	Mixed	Formal-	Fair
Diamondville	1,000	thrust Belt; orig- inally commercial coal for railroad shipment; decline when Hoover Dam built; coal mines dangerous due to gas pockets	and gas; coal power plant Boom in progress	ties and services short- ages; trailer parks; transiency Diamondville bedroom for Kemmerer; 50% mobile homes (Diamondville), 16% mobile homes (Kemmerer) 1980	serva- tive, Liber- aliz- ing		izing	
Evans ton	6,421	On Overthrust Belt; Mormon set- tlement; railroad town; coal but de- cline with other power services; coal mines danger- ous due to gas pockets; agricul- ture still impor- tant	Overthrust Belt oil and gas; Boom in progress	Rapid growth; facilities and services shortages; much transiency; amenities lacking; 20% mobile homes 1980. Strong Mormon in- fluence	Con- serva- tive, Con- flicts (Mor- mon)	Mixed, changing	Formal- izing	Poor
Lyman	2,284	Not relevant	Overflow bedroom communities for energy	Residential community, not full services and facilities; outside link-	Con-	Undifferen-	Largely	Poor
Mountain View	628		in Evans ton area	ages to regional towns; 52% mobile homes 1980.	serva- tive	tiated	Informal	



GREEN RIVER - HAMS FORK EIS COAL REGION

0 100 MILES



Map 3-6. Major Highways

AFFECTED ENVIRONMENT

Highways

Tables 3-31 and 3-32 show traffic volumes for both the Colorado and Wyoming roads by road segment in 1980 and 1981 respectively. These tables also show volume to capacity coefficients. If the capacity at peak hour traffic exceeds 1.00, a lowering of the service level will occur, indicating an impact on that road segment. A coefficient of .80 to 1.0 indicates a high probability for at least momentary or minor road congestion. The capacity figure is for level of service "C", which means traffic is able to average 50 miles per hour. The peak hour traffic is the 30th highest traffic hour that can be expected for the year. The tables show that most of the road segments in Wyoming and Colorado are at less than 50 percent of capacity during peak traffic hours. The transportation systems are adequate to meet present demands.

Tables 3-31 and 3-32 also show the number of traffic accidents for each of the road segments. The accident rate is based on the number of accidents which occur per million miles driven. The number of accidents for each year is determined by the following formula: Segment length *times* average daily traffic *times* accident rate *times* 365 *divided by* 1,000,000. The accident rates used are assumed to remain constant over time.

Railroads

The Denver and Rio Grande Western Railroad in Colorado runs between Craig and Denver and from Bond to Grand Junction. For trains moving east the major constraint on the line's capacity is the Moffat Tunnel, which is located between Bond and Denver. The Union Pacific Railroad is a double track mainline running east and west across the southern part of Wyoming. Most of the trackage is controlled by centralized traffic control, an advanced signaling system, with the balance controlled by an automatic block signaling system. Overall traffic for both railroads has declined since 1980 due to the current economic downturn.

There are highway at-grade crossings in Colorado that occur on the Denver and Rio Grande Western line from Craig to Denver and Bond to Grand Junction. Funds for any required grade separations

would be expected to come from Federal, state, and local governments as well as the railroad. Due to lack of data, no exposure factors or hazard ratings are given for the grade crossings on highways and other rural roads.

State highways in Wyoming have at-grade crossings with the Union Pacific mainline at only two places, Pine Bluff and Carter. Both of these crossings are scheduled for grade separation construction in 1984. At-grade crossings also occur with county roads, but no data is available to analyze the hazard ratings or exposure factors.

Noise

The general noise level in the study area is approximately 30 to 40 decibels in undeveloped areas, based on representative levels according to population densities (U.S. Department of Commerce 1977). However, specific areas such as highways, urban areas, power plants, and existing mining operations have noise levels significantly greater than the 40-decibel figure.

The existing noise levels next to highways generally range from 50 to 80 decibels equivalent continuous sound level, as shown in table 3-33. All figures are estimates; no actual measurements for any noise levels were made. The table also gives the distance to the 50-decibel contour, which is the distance from the road to the point the noise level would reach 50 decibels. The Environmental Protection Agency standard for noise in residential areas is 50 decibels. The existing traffic noise levels were estimated based upon the projected traffic volumes for each highway as shown in the Transportation section. Noise generated from rail traffic has an equivalent continuous sound level of approximately 75 to 80 decibels (at 100 feet) along the rail lines.

Noise is also generated by mining operations in the region. Strip mines and gravel quarry operations have an equivalent continuous sound level of approximately 78 decibels at 500 feet, while underground mines generate less noise (60 to 66 decibels). The adverse affects of noise depend upon the noise level, its source and location, sensitivity of receptors, barriers, and frequency range, among other variables.

TABLE 3-31

AFFECTED COLORADO HIGHWAYS

Road Segment	Route	Location	1980 ADT	DHV	1980 PHT	Capacity Vol. @ Svc. Level "C"	PHT Capacity	Segment Length	Accld. Rate	Total Accld.
A	U.S. Hwy 40	Craig to Lay	1,600	.14	192	910	.21	17.4	1.61	16
B	U.S. Hwy 40	Craig to Hayden	3,400	.12	408	680	.60	14.8	2.88	53
C	U.S. Hwy 40	Hayden to Steamboat Spgs.	3,800	.12	456	680	.67	23.4	2.53	82
D	St. Hwy 13/789	Craig to Hamilton	2,500	.12	300	790	.38	12.8	2.95	34
E	St. Hwy 13/789	Hamilton to Nine Mile Gap	1,350	.12	162	790	.21	22.9	3.28	37
F	St. Hwy 13/789	Meeker to Nine Mile Gap	2,050	.12	246	760	.32	10.9	3.84	31
G	St. Hwy 317	Hamilton to Pagoda	100	.20	20	640	.03	12.2	10.30	5
H	St. Hwy 394	Craig to Routt County Line	1,500	.15	225	740	.30	9.4	11.96	62
I	St. Hwy 131	U.S. Hwy 40 to Oak Creek	1,200	.20	240	620	.39	16.7	5.02	37
J	St. Hwy 131	Oak Creek to Yampa	1,100	.20	220	760	.29	9.4	15.42	58
K	U.S. Hwy 40	Lay to Dinosaur	700	.14	98	680	.14	68.1	1.70	30
L	St. Hwy 64	Rangely to County Rd #1	2,950	.12	354	820	.43	2.9	2.54	8

SOURCE: Colorado Department of Highways 1980.

NOTE: ADT = average daily traffic, DHV = design hourly volume, and PHT = peak hour traffic.

TABLE 3-32

AFFECTED WYOMING HIGHWAYS

Road Segment	Route	Location	1980 ADT	DHV	1980 PHT	Capacity	PHT Capacity	Segment Length	Accid. Rate	Total Accid.
						Vol. @ Svc. Level "C"				
A	I-80	Evanston to Green River	7,508	.12	901	4,380	.21	86	1.21	285
B	I-80	Green River to Rock Spgs.	12,143	.12	1,457	4,380	.33	14	2.15	133
C	I-80	Rock Spgs. to Creston Jct.	7,394	.12	887	4,380	.20	82	1.12	248
D	I-80	Creston Jct. to Rawlins	6,948	.12	834	4,440	.19	26	1.01	67
E	I-80	Rawlins to Sinclair	6,858	.12	823	4,620	.18	6	1.42	21
F	St. Hwy 71	Rawlins to 20 Mile Road	2,716	.12	326	1,056	.31	2	4.66	9
G	St. Hwy 789	I-80 to Baggs	897	.14	126	729	.17	51	1.64	27
H	St. Hwy 430	Rock Springs to State Line	351	.16	56	684	.08	63	1.08	9
I	U.S. Hwy 191	Rock Springs to Farson	2,100	.12	252	722	.35	41	2.35	74
J	U.S. Hwy 189	I-80 to Kemmerer	1,253	.15	188	564	.33	37	1.86	31

SOURCE: Wyoming State Highway Department 1981.

NOTE: ADT = average daily traffic, DHV = design hourly volume, and PHT = peak hour traffic.

TABLE 3-33
NOISE LEVELS FOR AFFECTED HIGHWAYS

Colorado Highways 1980			Wyoming Highways 1981		
Road Segment*	Leq (dB) @ 50 Ft.	Distance † to 50 dB Contour	Road Segment*	Leq (dB) @ 50 Ft.	Distance † to 50 dB Contour
A	69	450	A	79	1,450
B	71	600	B	80	1,600
C	71	600	C	78	1,350
D	73	700	D	79	1,450
E	72	650	E	78	1,350
F	72	650	F	71	600
G	50	50	G	78	1,350
H	62	200	H	76	850
I	62	200	I	71	600
J	62	200	J	70	550
K	68	400			
L	68	400			

SOURCE: Planning in the Noise Environment, U.S. Air Force et al., December 1976.

* Road segments are portrayed on the transportation map in the preceding section.

† Distance is given in feet and does not consider barriers, such as topography, or other noise sources adjacent to the highway.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This chapter addresses the impacts of the five alternatives described in Chapter 2: No Action, Low Production, Moderate Production, High Production, and Maximum Production. The No Action alternative portrays baseline development trends in the region through the year 2000. As described in Chapter 2, this alternative includes Little Middle Creek Tract as a potential emergency bypass lease but none of the other 23 coal lease tracts. The discussion of baseline trends focuses on development which could result in significant cumulative impacts when combined with new Federal coal leasing.

In turn, analysis of the four leasing alternatives focuses on two kinds of impacts: (1) significant cumulative impacts of leasing a given number of tracts in combination with projected baseline development and (2) significant localized impacts associated with individual tracts. Given the inconclusiveness, or lack, of certain data, the extent or significance of a few impacts cannot be determined. These impacts have been identified as potential problem areas and may need to be addressed in the permit application package required of the lessee prior to development. The overall emphasis of the analysis is on residual or unresolved impacts remaining after application of the mitigation requirements described in Chapter 2, which are considered part of the proposed leasing actions. Additional measures which could potentially mitigate adverse impacts are also presented.

There is no way to predict which coal lease tracts, or combination of lease tracts, may be leased, nor is there any way to predict in detail how a tract would be developed if it is leased. Therefore, a worst-case analysis has been used to (1) ensure that all potential significant impacts are considered and (2) identify problems which would affect the leasing decisions.

Impacts of the five alternatives are presented by resource or environmental component. Resources are dealt with in the same order as they are presented in Chapter 3. Alternatives are analyzed under each resource in the same order as they are introduced in Chapter 2, i.e., No Action, Low, Moderate, High, and Maximum.

ANALYSIS ASSUMPTIONS AND GUIDELINES

General

1. The following time frames are addressed:
1992
1995
2000
End of Mine Life
2. Mine construction would peak in 1992, with full production in 1995. In general, valid quantitative estimates of impacts cannot be made beyond the year 2000.
3. Three tracts are analyzed as extensions of existing mines. They would require no new employees, surface facilities, or transportation networks and would not increase the annual rate of acreage disturbed or annual production. These tracts are:
Little Middle Creek Tract
Tract 98
Deadman Tract
All other tracts are considered as new mines (worst-case analysis).
4. The analysis for each alternative assumes that all tracts would be leased and developed, even though what may realistically be expected to occur may fall short of this in any given alternative.
5. For all coal leased in the Green River-Hams Fork Coal Region, it is assumed that markets would be available either inside or outside the region.
6. It is assumed that normal environmental conditions would continue, i.e., no major natural disasters, such as 100-year floods or severe droughts, etc., would occur.
7. Coal recovery tonnages are based on a 50 percent rate for underground mines (room-and-pillar mining method) and an 85 to 90 percent rate for surface mines.
8. Secondary land use and disturbance is based on 80 acres disturbed per 1,000 increase in population. It is also assumed that such disturbance (urbanization, etc.) would not be reclaimed.
9. End of Mine Life equals end of production.

ENVIRONMENTAL CONSEQUENCES

10. Reclamation would be accomplished 12 years after end of mine life.
11. Postmining land use equals return to premining use.
12. Successful reclamation equals a return to a condition at least as good as premining condition. However, the wildlife habitat or native plant community that existed before mining may not have returned.
13. Irreversible/Irretrievable (Trends/Loss) means that an impact lasts for 60 to 100 years.
14. Short-term is defined as being up to end of mine life.
15. Long-term is defined as being beyond end of mine life.
16. Fee coal within tract boundaries would be developed if the Federal coal in the tract was developed; fee coal is included in the leasing level.
17. Cumulative impacts under the Low, Medium, and High alternatives would be insignificant if the analysis for the Maximum alternative yields insignificant cumulative impacts. Therefore, only the Maximum alternative is analyzed when the cumulative impact is insignificant.

Reclamation

Irrigation would be employed if necessary to avoid extensive delays in reclamation.

Land Use

1. All animal unit months (AUMs) available within the tract boundaries of a surface mine would be out of production until end of mine life. AUMs affected by subsurface tracts would involve only actual disturbed acres for surface facilities for that tract.
2. The threshold of significance for an individual ranching operation is assumed to be a 10 percent or more loss of the total operation.

Economics

1. All dollar values are in 1980 constant dollars except for assessed valuation figures, which are in 1973 constant dollars for Colorado and 1967 constant dollars for Wyoming. Those figures are not adjusted for inflation because

bonding limits are based on the official published values.

2. Community population figures include estimates of populations in the surrounding areas outside city limits. Therefore, most 1980 community populations used in this EIS are larger than census figures, which are for city limits only.

AIR QUALITY

In order to determine the contribution of additional coal lease development to air quality impacts, pollutant concentrations were estimated using atmospheric dispersion modeling (principally the Environmental Protection Agency approved Industrial Source Complex dispersion model). This model predicts the resulting ground level pollutant concentrations by taking into account topography, wind speed and direction, and industrial/residential emission characteristics.

The following steps were necessary during the analysis:

1. Determine "worst-case" meteorologic conditions and the specific modeling approaches (modified to include terrain and particulate deposition considerations) needed to predict impacts.
2. Specify the modeling region to determine boundaries, topography, background pollutant concentrations, and sensitive receptors.
3. Specify sources and population/production levels to determine pollutant emission levels.

Results must be evaluated with an understanding of the general limitations of air quality modeling. No detailed mine plans were available; therefore, air pollutant impacts were modeled conservatively ("worst-case") and generically. Actual industrial development will require additional detailed review in order to obtain necessary air quality permits (i.e., Prevention of Significant Deterioration permit applicability review, State Air Contaminant Emission Notice and Permit, and others). However, predicted pollutant concentrations do indicate potential air quality problem areas. The following discussion summarizes the modeling results. A detailed presentation of the modeling activities is found in the *Technical Report on Climate and Air Quality for the Green River/Hams Fork Round II Coal Leasing EIS* (Radian Corporation 1983b) and in various *Climate and Air Quality Site Specific Analyses* (Radian Corporation 1983a); these reports are available for review at the BLM Colorado State Office in Denver, Colorado.

ENVIRONMENTAL CONSEQUENCES

Even without additional Federal coal leasing as proposed, there will continue to be impacts to air quality in the EIS area. Increased emissions reflect the continued urbanization of the area, and operation of other industrial sources (i.e., existing and new energy development, transportation, etc.).

The predicted annual total suspended particulate concentrations (including background, additional and total concentrations) are summarized in table 4-A and displayed in Figures A5-1 to A5-7 (Appendix 5). These values represent the “worst-case” concentrations which could occur from planned or existing sources (without additional Federal coal leasing). Due to the variation in short-term meteorologic conditions throughout the region, only annual average values are presented. While most of the region is predicted to remain below the total suspended particulate annual Ambient Air Quality Standards, some urban areas may continue to exceed the standard and three rural areas (locations R3, R4, and R5 on figures A5-2 and A5-3) are expected to exceed the standard due to expanded industrialization.

Detailed analyses of the potential air quality impacts from additional Federal coal leasing were performed for each proposed tract on a site-specific basis and on a combined regional basis for the Maximum Leasing alternative. Regional impacts under lower leasing alternatives would be commensurately lower. The impact analyses indicated that no perceptible visibility impairment is expected from any of the proposed lease developments. Due to the limited levels of sulfur and nitrogen related pollutants from coal mining, no significant impacts due to atmospheric deposition are expected.

Table A5-1 (Appendix 5) summarizes the emission and production rates assumed for proposed lease tracts located on map 2-1. Emissions estimates include control technologies that are currently in use at western coal mines and recognized as best available control technology. Increases in pollutants for population centers were estimated by scaling current (1978-82) emission levels with increased population projections.

As stated in Chapter 3, Affected Environment, several towns in the study area exceed the total suspended particulate Ambient Air Quality Standard. The significance of total suspended particulate violations may change once the EPA implements a fine particulate standard. Currently, predicted total suspended particulate concentrations should be compared to the appropriate Air Quality Standard to determine the relative significance of anticipated impacts.

Regional Analysis

The maximum predicted annual total suspended particulate concentrations (including background, additional, and total concentrations) are summarized in table 4-A and displayed in figures A5-1 to A5-7 (Appendix 5). These values represent the “worst-case” concentrations which could occur from existing and additional sources at the proposed Maximum Leasing alternative level.

Although predicted regional air quality impacts due to additional Federal coal leases (direct and secondary) would not be significant by themselves, population increases due to additional mining may increase pollutant levels in towns which already exceed the annual total suspended particulate Ambient Air Quality Standard (Craig, Steamboat Springs, and Rock Springs). It would be difficult to actually measure the modeled variation due to mine-related growth, given the relatively large annual variation in pollutant concentrations. Moderate increases in regional total suspended particulate concentrations are predicted due to the proposed Fish Creek Tract (location R9 on figure A5-7), but these impacts would be well within the ambient standards.

Site-Specific Analysis

The values summarized below represent maximum impacts under “worst-case” ambient conditions 500 meters beyond the proposed tract boundaries. On-tract maximum values are not considered “ambient” by regulatory agencies and are therefore not included in this analysis. The locations and values for the points of maximum impact may vary by development year because of changes in assumed mine configuration.

The predicted 24-hour and annual total suspended particulate concentrations for each proposed tract (including background concentrations) are shown in table A5-2 (Appendix 5). These levels represent the “worst-case” concentrations which could result from direct mining activities. Differences in predicted impacts between proposed tracts should be expected due to variations in mine configuration, emission source density, topography, and specific meteorology. For example, a surface mine configuration may have greater total particulate emissions than an underground development, but the process facilities may be further from tract boundaries, the emission sources may be distributed throughout the tract, and the topography may be relatively flat, resulting in lower predicted pollutant concentrations than for the underground mine.

TABLE 4-A

SELECTED "WORST-CASE" REGIONAL TOTAL SUSPENDED
PARTICULATE CONCENTRATIONS*

Receptor Location**	No Action Alternative Annual Concentration			Maximum Alternative Annual Concentration		
	Background	Additional 2000	Total 2000	Background	Additional 2000	Total 2000
<u>Southwest Wyoming</u>						
R1	43	†	†	43	9	52
R2	<u>83</u>	25	<u>108</u>	<u>83</u>	29	<u>112</u>
R3	<u>35</u>	28	<u>63</u>	<u>35</u>	28	<u>63</u>
R4	35	26	<u>61</u>	35	26	<u>61</u>
<u>South-Central Wyoming</u>						
R5	34	37	<u>71</u>	34	37	<u>71</u>
R6	34††	15	<u>49</u>	34††	24	<u>58</u>
<u>Northwest Colorado</u>						
R7	20	7	27	20	7	27
R8	<u>87</u>	6	<u>93</u>	<u>87</u>	8	<u>95</u>
R9	<u>21</u>	0	<u>21</u>	<u>21</u>	30	<u>51</u>
R10	<u>134</u>	†	†	<u>134</u>	3	<u>137</u>

SOURCE: Radián Corporation, 1983b.

NOTE: Underlined values indicate potential violation of Ambient Air Quality Standards (primary annual 75 micrograms per cubic meter, secondary annual 60 micrograms per cubic meter). These are considered unclassified under EPA's standards (neither attainment nor nonattainment areas); see Chapter 3 for further discussion.

* Concentrations in micrograms per cubic meter.

** Receptor locations on Figures A5-1 through A5-7 in Appendix 5.

† Modeling of increased impacts for No Action was not performed due to the minimal increase in emission sources above background.

†† Background values for Rawlins are not available; however, a subregional average was substituted.

ENVIRONMENTAL CONSEQUENCES

While all of the proposed tracts are predicted to remain below the annual Ambient Air Quality Standards, impacts from the proposed Leucite Hills Tract are predicted to approach, and the proposed Peck Gulch and Fish Creek tracts to exceed, the 24-hour total suspended particulate standard. The Peck Gulch and Fish Creek tracts are included under the High and Maximum Leasing alternatives, and their predicted impacts are due to concentrated processing facilities near or outside the tract boundaries. The Leucite Hills Tract is proposed under all leasing alternatives; its major impacts are due to an off-tract processing facility.

Gaseous pollutant concentrations were modeled at the proposed Indian Springs facility, but not at the other proposed tracts due to the relatively small amount of gaseous emissions (Radian Corporation 1983a). Gaseous pollutant impacts for Indian Springs were modeled based on the following assumed emission values (in tons per year); oxides of nitrogen-955, sulfur dioxide-1533, carbon monoxide-294, and hydrocarbons-57. Based on these values, maximum modeled gaseous pollutant concentration values for 1995, 2000 and end of mine life (in micrograms per cubic meter) are: annual sulfur dioxide-48, 24-hour sulfur dioxide-30, 3-hour sulfur dioxide-86, and annual oxides of nitrogen-30. These results, although too preliminary to be used for regulatory purposes, indicate a potential for exceeding the Annual Prevention of Significant Deterioration Class II sulfur dioxide increment; further analysis would be required once detailed development plans were submitted for Prevention of Significant Deterioration applicability review by regulatory agencies.

In summary, air quality impacts from the proposed Leucite Hills Tract are predicted to be high, but within standards, under all leasing alternatives. Under the High and Maximum Leasing alternatives, short-term violations of the total suspended particulates standard are predicted near the proposed Peck Gulch and Fish Creek tracts, and the annual Class II sulfur dioxide increment is predicted to be exceeded by the proposed Indian Springs facility.

Unavoidable Adverse Effects

Pollutant emissions from direct development of additional Federal coal leases and induced, secondary sources would have an unavoidable adverse impact on air quality. When compared to applicable standards, significant impacts are predicted only near the proposed Peck Gulch, Fish Creek and Indian Springs tracts. Although within standards, major impacts are also predicted for the proposed Leucite Hills Tract.

Irreversible or Irretrievable Commitments of Resources

Direct impacts will occur only for the life of the proposed mines, but irreversible and irretrievable commitments could occur because of continued urbanization in the region (secondary impacts).

Short-Term Use vs. Long-Term Productivity

Short-term impacts would continue during the life of the proposed mines. However, once the coal lease areas were decommissioned and stabilized, no direct impacts to air quality would remain.

Potential Mitigation

Potential mitigation of adverse impacts could include additional control of emissions from existing sources, increased study of pollutant impacts, and additional background monitoring to better assess regional impacts.

GEOLOGY, TOPOGRAPHY, AND MINERALS

Physiography and Topography

Although the physiography of the region would remain unchanged under both the No Action and the four leasing alternatives, the topography would be impacted even without additional Federal coal leasing. Topographic modification would occur under the No Action alternative because of existing and future mineral exploration and development as well as associated population growth.

The development alternatives would increase the amount of topographic modification in the region. Topography would be altered from its original configuration on surface mined areas, but spoils would be backfilled into the mines and recontoured to a natural appearance during reclamation.

However, a significant local alteration of the present topography on Tract 98 (all leasing alternatives) could occur if the tract qualified for an exemption under Section 527 of the Surface Mining Control and Reclamation Act for special bituminous

ENVIRONMENTAL CONSEQUENCES

surface coal mines. An exemption would allow the highwall and spoils piles to remain after mining and reclamation occurred, without backfilling and recontouring. The determination of qualification for the exemption would be made by the Wyoming Department of Environmental Quality when the mine plan was approved.

Subsidence is a potential hazard associated with underground mining (coal, oil shale, trona, etc.). The impact of subsidence on topography is not significant, since some areas would be protected from subsidence by leaving coal reserves in place and subsided areas could be reclaimed to restore a natural appearance.

Subsidence is dependent on several variables, including mining methods, lithology and thickness of overburden, mining rate and seam thickness, and design (geometry) of mine workings. The greatest amount of subsidence occurs over the center of mined out areas and decreases outward toward areas underlain by pillars and panels (USDI BLM 1978a). Surface expressions of subsidence could include open fractures, buckled and bulged bedrock, sinkholes, and other depressions. A potential topographic problem associated with subsidence is damage to structures and natural resource lands located over mined areas.

The impact of subsidence can be mitigated by adequate mine design engineering. A subsidence control plan is required by the Office of Surface Mining to protect structures and renewable resource lands from adverse impacts.

Subsidence is expected to occur over subsurface mines under the four development alternatives. The magnitude of surface lowering could vary from visually undetectable to several feet. Fifty percent extraction room-and-pillar mining could experience subsidence of about 15 percent of mining height. The maximum estimated subsidence (multiple seam mining) is 7 feet for the Signal Butte Tract, while less than 1 foot is estimated for the Middle Creek Tract. By the end of mine life, subsidence could affect 12,600 acres under the Low alternative, 16,600 acres under the Moderate alternative, 30,000 acres under the High alternative, and 40,300 acres under the Maximum alternative.

An undetermined quantity of coal may have to be left in place to protect structures and renewable resource lands (see Land Use). This impact to recoverable coal resources would need to be addressed at the mining plan stage for tracts that would be underground mined.

The Indian Springs Tract, if leased under the High and Maximum alternatives, would be mined by in situ coal gasification. In situ coal gasification involves the injection of oxygen and steam to sustain

subsurface burning of the coal, which produces methane, carbon monoxide, and carbon dioxide gases. Since this type of mining is a developing technology, the surface expression and style of subsidence over burned areas cannot be accurately predicted. Subsidence monitoring would be necessary during operations, with reclamation to be conducted as required. (See mitigation measures in Appendix 6.)

Stratigraphy

The impacts associated with the four development alternatives would not be significant. The principal impacts from surface mining would be the transformation of the overburden strata into spoils.

The impacts would be the loss of the geologic history (depositional environments and paleoecology) recorded in the strata, decrease in the bearing strength (stability) of the backfilled spoils, and hindrance of seismic exploration for oil and gas in underlying strata by unpredictable, i.e., slower and variable travel times of seismic waves through the spoils.

Paleontology

The impact to the paleontology resources of the EIS region cannot be assessed adequately because the EIS region has not been inventoried in detail. Some areas that have been inventoried have yielded significant fossils.

Paleontological resources would be impacted under the No Action and development alternatives by current and projected future development within the region. Fossils would be damaged or destroyed by surface mining. The committed mitigation for paleontology, as outlined in Appendix 6, should lessen potential impacts. It should be noted that subsurface paleontological information that would normally not be available may be uncovered during mining and could be studied and sampled. However, it is anticipated that without a monitoring program, most fossils would be overlooked or not recognized and would be destroyed or lost in the spoils. The construction of ancillary facilities for coal and other projects in the region could also destroy fossils.

Population increases within the region, coupled with construction of additional roads, would result in increasing the access to paleontological sites. Unauthorized collection and vandalism of fossils would almost certainly occur as a result.

ENVIRONMENTAL CONSEQUENCES

Geologic Hazards

The potential for geologic hazards increases with increased development in the region. The magnitude of the impacts is the major difference between the development and No Action alternatives. The impacts of geologic hazards associated with earthquakes, landslides, coal bed burning, and subsidence are not expected to be significant. They can be mitigated by identifying the potential hazards and implementing responsible engineering design and practices.

The majority of the region is considered to be in a zone of low seismicity; however, recurrent fault movements have caused earthquakes in southcentral Wyoming. There is a 10 percent probability that there may be a seismic event (earthquake) of sufficient magnitude to impact mining activities within southcentral Wyoming within the next 50 years (USDI BLM 1978b). The type of impacts that could result from an earthquake include those discussed below.

Construction activities, particularly excavations, may locally increase the potential for landslides. Proper engineering design and construction methods can mitigate potential landslide hazards. An earthquake of sufficient magnitude could cause slumping in the highwalls of surface mines. A potential landslide hazard has been identified for a tract introduced under the Moderate alternative: Atlantic Rim Tract has landslides associated with a major fault in Slide Draw.

A common geologic hazard associated with coal mining is the spontaneous combustion and uncontrolled burning of coal beds. The major impacts of this hazard are the loss of coal resources and a potential for surface fires. The significance of coal bed burning, which is uncontrollable and unavoidable, cannot be determined, although it is a potential problem in Western mines (U.S. Geological Survey 1980).

Subsidence could result in several potential problems. Aquifer communication could occur along fractures, and fractures that intersect the surface could divert streams and surface runoff to aquifers or mine workings (Dunrud 1976). The potential impacts of subsidence upon the groundwater and surface water systems are elaborated in the Water Resources portion of this EIS. Increased stresses in the overburden resulting from coal extraction could cause squeezes, bumps, and roof falls that would pose a threat to employees, equipment, and continuation of mining. An earthquake could cause subsidence along pre-existing fractures above underground mines (USDI BLM 1978b).

Methane deposits or pockets could be intersected during subsurface mining, and, because of methane's inflammable nature, this would pose a hazard for employees and equipment. The hazard could be minimized by slowly releasing the gas pressure by drilling prior to coal excavation, and perhaps by flaring, where practical. Methane deposits remaining in the overburden could be inadvertently intersected by subsidence fractures and degassed to the surface. Woody plants may be killed in areas of degassing, since the methane is used by certain types of bacteria to produce hydrogen sulfide and nitrous oxide, both of which disrupt root transpiration (Dunrud 1976).

This degassing of methane is unavoidable if methane pockets are intersected. The impact would be confined to a relatively small area. The Northeast Cow Creek Tract (Maximum alternative), if leased, would be a subsurface mine that has a high potential for methane problems. This is because methane has been observed in test holes and wells completed in the stratigraphic units proposed for mining. The potential for methane occurrences in other subsurface tracts is not known because of a lack of data.

Mineral Resources

Coal

Under the No Action alternative, coal production within the EIS region without additional Federal leasing is projected to be 37.3, 58.5, 60.9, and 74.2 million tons in 1983, 1992, 1995, and 2000, respectively. In the checkerboard areas of Wyoming, the private and state coal would probably not be developed. Economic development of the area normally requires a continuous block of developable coal.

Annual coal production would increase by 2.1 million tons and result in the recovery of 101.1 million tons of an in-place coal resource of 341.2 million tons under the Low alternative by the end of mine life. The Moderate alternative would increase coal production by 15.0 million tons per year and ultimately recover 495.3 million tons of an in-place coal resource of 1,276.8 million tons. The High, or Preferred, alternative would increase coal production by 22.6 million tons per year and recover 759.3 million tons of an in-place reserve of 1,924.7 million tons, while the Maximum alternative would increase annual production by 28.9 million tons and recover 990.7 million tons of 2,449.9 million tons of in-place coal.

A significant local impact was identified in the site specific analysis of the Northeast Cow Creek

ENVIRONMENTAL CONSEQUENCES

Tract (Maximum alternative). This tract is proposed to be leased only as a subsurface mine. However, if the two subsurface coal seams were mined, approximately 28 million tons of surface mineable coal in the Garden Gulch seam might not be recoverable. Underground mining could cause subsidence and/or unsafe floor conditions for surface mining.

The mineable coal seams do not outcrop within the Bell Rock Tract (Maximum alternative), and development would require the sinking of deep shafts. The economics and technology of this type of development are questionable. It should be noted, however, that the tract could be developed as an extension to Empire Energy's existing Eagle Mine.

Conservation of the coal resource would not be achieved for the Lay Creek Tract (Maximum alternative). All of the surface mineable coal in the area is included in the Lay Creek Tract, except those areas determined unsuitable because of wildlife considerations. The unsuitable areas would preclude development of approximately 19 million tons of recoverable coal scattered through the area. Should wildlife use or the laws and regulations protecting these wildlife areas change, the economics of returning to the area after tract development to mine 19 million tons of scattered coal would be questionable, given present coal prices.

Coal recovery is generally 85 to 90 percent of mineable coal for surface mines and 50 percent for subsurface mines. The coal that was not recovered would be irretrievably lost for future uses. Unrecoverable coal would be left in the pit margins and mixed in the spoils in surface mines, and left in pillars and barrier panels in subsurface mines to mitigate subsidence.

Oil and Gas

No significant conflicts would occur between coal development and oil and gas development. Oil and gas exploration and production would continue, with possible problems with existing, planned, and potential coal development and production under both the No Action and development alternatives. These problems would have to be worked out by the leaseholders and should not constitute a significant impact on the production and development of energy resources.

The potential for problems would increase from the Low to the Maximum alternative, since more acreage would be leased for coal development. However, the potential for the development of producing oil and gas leases within the proposed coal lease tracts cannot be predicted at this time. Oil and gas production established prior to coal mining

could preclude a portion of the coal leases to protect the wells.

Other Minerals

The exploration for and development of other mineral resources are not expected to cause any significant conflicts with the development of coal resources under either the No Action or the development alternatives. The main impact of coal leasing would be an increase in the potential for mineral conflicts, since more acreage would be available for development. Conflicts with existing mineral claimants would have to be resolved by the lessee and the claimants themselves. The location of mineral claims within coal lease tracts after leasing would probably be precluded.

Unavoidable Adverse Effects

Under all four leasing alternatives, an unknown number of paleontological resources would be unavoidably disturbed or destroyed. In addition, the topography of Tract 98 could be significantly altered, depending on the determination for exemption from regulations.

Under the Moderate through Maximum Alternatives, landsliding may be an unavoidable impact on the Atlantic Rim Tract.

The surface expression and style of subsidence resulting from in situ coal gasification within the Indian Springs Tract (High and Maximum alternatives) is unknown and cannot be accurately predicted.

If the Maximum Leasing alternative was selected, approximately 28.0 million tons of surface mineable coal in the Northeast Cow Creek Tract and 19.0 million tons of surface mineable coal in the Lay Creek Tract may not be recoverable. In addition, methane deposits remaining in the overburden of the Northeast Cow Creek Tract could be unavoidably degassed to the surface if intersected by subsidence fractures.

Short-Term Use vs. Long-Term Productivity

The Northeast Cow Creek Tract is proposed for leasing under the Maximum alternative. Leasing and development of the 91.6 million tons of recoverable subsurface coal under the Northeast Cow Creek Tract could cause subsidence or unsafe floor

ENVIRONMENTAL CONSEQUENCES

conditions, which in the long run could preclude later leasing and development of the 28 million tons of recoverable surface coal in the Garden Gulch seam.

Development of the Indian Springs Tract (High and Maximum alternatives) could contribute to technology of in situ coal gasification. However, development could preclude the ability to take advantage of future developments that could result in increased efficiency and an ability to predict subsidence effects.

In the short term, development of the Lay Creek Tract (Maximum alternative) would preclude the long-term mining of 19 million tons of recoverable coal.

Irreversible or Irretrievable Commitments of Resources

An unknown quantity of paleontological resources would be disturbed or destroyed as a result of coal mining activities under any of the leasing alternatives. Depending on the determination for exemption to regulations, the topography of Tract 98 (all leasing alternatives) could be significantly altered.

SOILS

Energy development activities occurring in the seven-county region would have a significant short-term effect on the soils resource. Impacts to the soils would result directly from activities such as mining, pipelines, oil shale, and development of transportation routes and urban areas.

Soil productivity would be affected in various ways. Activities such as mining, which would require the removal of the surface and subsurface soils, would have the most significant effect. Removal of these soils from the area would destroy the natural soil characteristics by pulverizing the soil structure, disrupting the organic matter cycle, and causing compaction. The microorganism population and nutrient cycling processes would be upset by movement and redistribution of the soil. The compaction of the soil would result in conditions that would be conducive to erosion. There would be a change in soil moisture relationships and infiltration and permeability rates. The net effect would be a reduction or loss in soil productivity in the short term and the loss of the developed soil community.

Development of transportation systems and urban areas would constitute a long-term commitment of the soil resource. This type of development would result in a loss of soil due to erosion during construction phases and an acreage loss of the soil resource itself.

As table 4-1 shows, activities associated with the No Action alternative would disturb 236,725 acres by the year 2000. Soil productivity would be reduced over the short-term period (life of the project) due to mining activities, pipelines, etc. A short-term loss or interruption in organic matter and nutrient cycling processes and microbiota populations would result, which affects soil productivity. There would be a long-term loss in soil productivity on projects associated with transportation systems and urban development. Wind and water erosion would cause an unknown quantity of topsoil displacement.

The types of impacts associated with leasing alternatives would be the same. The magnitude of the impacts would increase from the Low to the Maximum alternative.

Impacts to soils from coal development would be insignificant in the long term, because soil loss and the reduction of its productive capacity is expected to be minimized with implementation of effective erosion control structures and reclamation procedures. Some unquantifiable soil loss resulting from wind and water erosion would occur until erosion control structures were in place. A few small unquantifiable areas (mainly abrupt steep slopes and areas with unfavorable physical and chemical properties) would be subject to accelerated erosion and require intensive management and continuing follow-up erosion control measures.

Reclamation

Both Colorado and Wyoming have assumed primary jurisdiction, in cooperation with the Office of Surface Mining, over regulation of coal development within their respective boundaries. The two states' specific regulations and standards may differ, but the overall goal of successful reclamation is consistent. The minor differences in regulations used by each state result in the flexibility necessary to meet site-specific problems and utilize improvements in technology.

Species diversity requirements for each state require that the species composition be suitable for the proposed land use (wildlife habitat, livestock grazing, etc.) and that the vegetation be capable of renewing itself under natural conditions. In addition, herbaceous cover and productivity and woody plant

TABLE 4-1
SOIL DISTURBANCE

Alternatives	Acres Disturbed				EML
	1983	1992	1995	2000	
No Action:					
Coal development	21,196	33,441	33,748	42,756	
Other	140,472	169,995	178,815	193,969	
Total	<u>161,668</u>	<u>203,436</u>	<u>212,563</u>	<u>236,725</u>	
Low:					
Coal development *	-0-	525	1,053	2,069	6,627
Secondary †	-0-	61	113	113	113
Sub-total	-0-	586	1,166	2,182	6,740
Total °	<u>161,668</u>	<u>204,022</u>	<u>213,729</u>	<u>238,907</u>	<u>6,740</u>
Moderate:					
Coal development	-0-	3,407	5,879	9,729	20,510
Secondary	-0-	130	553	553	592
Sub-total	-0-	3,537	6,432	10,282	21,102
Total °	<u>161,668</u>	<u>206,973</u>	<u>218,995</u>	<u>247,007</u>	<u>21,102</u>
High:					
Coal development	-0-	4,535	7,665	12,185	25,024
Secondary	-0-	313	899	1,083	1,122
Sub-total	-0-	4,848	8,564	13,268	26,146
Total °	<u>161,668</u>	<u>208,284</u>	<u>221,127</u>	<u>249,993</u>	<u>26,146</u>
Maximum:					
Coal development	-0-	6,318	10,149	16,004	33,355
Secondary	-0-	442	1,463	1,463	1,463
Sub-total	-0-	6,760	11,612	17,467	34,818
Total °	<u>161,668</u>	<u>210,196</u>	<u>224,175</u>	<u>254,192</u>	<u>34,818</u>

* This represents extraction area, portals, on & off site facilities, roads
railroads, telephone and power lines

† This represents secondary impacts from urban development

° This represents the No Action total plus the individual alternative total

ENVIRONMENTAL CONSEQUENCES

densities on reclaimed areas must be at least equal to those on premining vegetation communities. This needs to be demonstrated two years prior to releasing the bond. The bond liability period for areas receiving less than 26 inches of annual precipitation is 10 years after the last cultural practice.

The time frames and techniques used for reclamation vary between Wyoming and Colorado because of local climate and soil conditions associated with each state. Generally, the soils in Wyoming have lower reclamation potential due to low precipitation and the unfavorable physical and chemical soil properties which are normally established under semi-arid conditions. These factors, therefore, dictate the techniques needed for successful rehabilitation and the time required for vegetation establishment. Advanced techniques may need to be incorporated into the reclamation process to increase the probabilities of success.

Existing vegetation community types are also important factors in reclamation. Wildlife habitat, e.g., mountain shrub, riparian, and aspen types, requires considerably more time and effort to re-establish than a lower successional stage, such as sagebrush or grassland communities. Therefore, impacts to wildlife are generally more than those associated with other types of land uses, such as livestock grazing (see Animal Life for a discussion of impacts to wildlife).

There are a number of potential reclamation problems associated with some of the proposed coal tracts located in both Colorado and Wyoming. Many of the adverse factors which affect the reclamation potential of a given area and are controllable are routinely and successfully dealt with by existing mines during the reclamation process. These routine factors will therefore not be considered further. Included in this category are slopes less than 40 percent, clay subsoils, rocky soils, shallow soils, seeding depth, adapted species, water erosion, and competition from undesirable species.

Some specific problems which *would* affect the success of reclamation are limited precipitation, wind erosion, availability of suitable plant growth material, slopes exceeding 40 percent, and soil chemistry. Based on these factors that restrict reclamation success, the proposed coal tracts can be divided into low, moderate, and high reclamation potential categories.

All of the proposed tracts in Wyoming are considered to have low reclamation potential. The low potential of these sites causes difficulties in re-establishing vegetation communities, so reclamation of these tracts is problematic. The vegetation communities within these Wyoming tracts have developed under the relatively extreme combination of semi-

arid climate, diverse topography, and diverse soil characteristics.

Prairie Dog, Signal Butte, Iles Mountain, Horse Gulch, and Lay Creek tracts in Colorado are categorized as having moderate reclamation potential and possess one or more of the adverse factors affecting reclamation success.

The remaining tracts in Colorado should not experience reclamation problems, given the reclamation success on adjacent areas, available plant growth media, existing environmental conditions, and existing reclamation regulation requirements. All factors affecting reclamation in these areas are considered common and are dealt with by normal reclamation techniques. For these reasons, the remaining Colorado tracts are considered to have high reclamation potential.

Table 4-R provides a breakdown of the individual problems associated with each proposed tract.

Low Precipitation

The average annual precipitation for Wyoming tracts is approximately 7 to 9 inches. Reclamation success on these tracts depends primarily on the conservation and efficient use of the limited precipitation.

As a rule of thumb, approximately 10 inches of precipitation are necessary to sustain revegetation attempts (National Academy of Sciences 1974; Valentine 1980). It is for this reason that additional cultural practices, such as irrigation systems and extensive mulching, would be required to establish a vegetation cover. There is no dispute as to whether vegetation can be established with advanced technology; however, the question still remains as to whether this productivity can perpetuate itself under natural conditions over the long term.

Low precipitation affects the chemistry of the soils by reducing the leaching process and results, in some cases, in the development of native soils possessing toxic levels of sodium. High sodium levels decrease the amount of moisture available for the establishment of plant communities on disturbed sites.

Soil Depth and Chemistry

All of the tracts in Wyoming and two of the proposed tracts in Colorado, Prairie Dog and Iles Mountain, lack adequate topsoil material. Thus there is limited suitable topsoil for a plant growth medium. In some cases, suitable overburden may be used as a replacement; if not, topsoil must be

TABLE 4-R
POTENTIAL RECLAMATION PROBLEMS

Low Alternative	Low Precip.	Wind Erosion	High Evp. Rates	Lack Topsoil Materials	Unfavorable Soil Chemistry	Steep Slopes 40%
Deadman	X		X	X	X	
Leucite Hills	X		X	X	X	
Point of Rocks	X		X	X	X	
Tract 98	X		X	X	X	
Prairie Dog				X	X	
Little Middle Ck.						
<u>Mod. Alternative</u>						
Atlantic Rim	X		X	X	X	X
Byrne Creek	X		X	X	X	
Corral Canyon	X		X	X	X	
Wild Horse Draw	X		X	X	X	
Rattlesnake Mesa						
Signal Butte		X				
<u>High Alternative</u>						
Pio	X		X	X	X	
Winton	X		X	X	X	
Indian Springs	X		X	X	X	
Peck Gulch						
Hies Mtn.				X		
Fish Creek						
<u>Max. Alternative</u>						
Northeast Cow Ck.	X		X	X	X	
Bell Rock						
Williams Fork Mtn.						
Lay Creek		X			X	
Horse Gulch		X			X	

Reclamation Potentials

Low- those tracts having more than two potential problems associated with their subject areas.

Moderate- those tracts having at least one or two negative factors.

High- those tracts which have no uncommon problems associated with the area.

ENVIRONMENTAL CONSEQUENCES

hauled in. This potential reclamation problem would not impact the soils, due to regulations, but would increase the difficulty of reclamation, primarily the handling of plant growth media.

The lack of existing suitable topsoil material may, in some cases, be a result of toxic levels of sodium, resulting in an unfavorable sodic condition, or of existing saline or alkali soil structures. This is true for all tracts in Wyoming and the Lay Creek, Horse Gulch, and Prairie Dog tracts in Colorado. Therefore, material from areas within the tract boundaries possessing deeper soil structures would have to be used to provide topsoil for areas lacking existing topsoil depth or suitability.

In some cases, it is possible to use overburden as topsoil material if it meets the requirements set forth for a suitable plant growing material. Unsuitable overburden materials are either (1) covered with additional material to assure that the minimum requirement of suitable material is on the surface or (2) treated with additives to enhance suitability.

Toxic material would have to be buried below the rooting zone. The lessee's reclamation plan for these tracts should deal with the chemical limitations of soluble salts by burying the material and providing a plant growth medium from areas of deeper soils or suitable overburden.

Three tracts in Colorado--Lay Creek, Signal Butte, and Horse Gulch--could experience problems with wind erosion. Although wind erosion is not an existing problem for these areas, disturbing large areas of these tracts would eliminate natural windbreaks, creating potential wind erosion problems due to topography and the sandy texture of the existing soils. This problem would result in decreased soil stability and provide a sandblasting effect to newly established seedlings. Measures to prevent this type of erosion should be addressed in the reclamation plans for each of these tracts.

Steep Slopes

The area involved with the Atlantic Rim Tract in Wyoming has steep slopes in excess of 40 percent which are proposed for mining. This would cause difficulties in reclamation. Recontouring would be required to stabilize these slopes and complete the revegetation process. This alteration of the topography would result in the elimination of existing vegetation communities normally associated with steep, shallow slopes. Disturbed and unprotected sites on steep slopes may be severely eroded. In addition, the loss of moisture contributed by springs to Separation Creek would make it difficult to reestablish riparian and aspen vegetation during reclamation.

Long-Term Reclamation

Although the reclamation procedures currently required in Wyoming and Colorado appear adequate to restore original production levels, many problems remain that require additional research. The goals for successful reclamation are basically two-fold. The goal of short-term reclamation is to stabilize soils and topographic features to minimize erosion or other losses of topsoil substrata. The bulk of the research that has been accomplished has focused on this goal. The longer-term goal of establishing a vegetation community capable of supporting pre-mining land uses and possessing the capability of renewing itself under natural conditions is much more difficult to accomplish. More research is needed on this long-term reclamation process. Because more research is needed, the long-term stability of the reclaimed environment is still largely unknown. The permit application package will have to address the special problems discussed for the various tracts in this section.

WATER RESOURCES

Surface Water

Under the No Action and the various leasing alternatives, development would impact surface water resources both onsite and to the receiving waters downstream, which are the North Platte, Green, Yampa, and White rivers. Impacts would include:

1. Channel modification--the alteration or removal of existing stream channels in surface mined areas
2. Subsidence effects--possible results to surface drainage if subsidence occurs
3. Water use--results of increased consumptive use of water
4. Urban water pollution--the pollution of rivers by sewage effluent
5. Salt loading--increased salinity of receiving waters downstream
6. Sediment yield--effects of erosion and sedimentation

Channel Modification

Surface disturbances in conjunction with surface and underground mining as a result of the leasing

ENVIRONMENTAL CONSEQUENCES

of new Federal coal would alter or remove all natural stream channels, insignificant flood plains, and existing reservoirs (stockponds, etc.) within disturbed areas. These impacts should be very local, relatively minor, and generally short-lived because of regulations enforced by the Colorado Mined Land Reclamation Board and Wyoming Department of Environmental Quality. Because of restrictions on mining on alluvial valley floors and within 100 feet of perennial or intermittent streams, channel disturbance would be limited primarily to ephemeral streams. Moreover, regulations require that disturbed channels be restored to a condition that approximates premining stream channel characteristics. The protection afforded perennial and intermittent streams and the required efforts to reconstruct 'stable' channels in reclaimed areas should minimize impacts to stream channels.

The number of reservoirs removed under the various leasing alternatives are listed in table 4-2. As most of these reservoirs have a remaining capacity of less than 3 acre-feet and are rapidly filling with sediment, the impact would be minor and could be easily mitigated by the construction of new reservoirs on the reclaimed surface. (Water rights listed in the table are discussed under Water Use, while springs and wells are covered in the Groundwater, Aquifer Removal Section.)

The concentration of transportation routes through Dugway Canyon could cause minor impacts to the North Platte River, including decreased channel stability, increased streambank erosion, and disturbance of flood plains, with secondary impacts to recreation due to decreased fishing. Alternate routing of transportation would mitigate this impact.

The No Action alternative's impact to channels and wetlands would arise from scattered noncoal development on private surface lands similar to that described for the leasing alternatives. Impacts from noncoal development would be largely unmitigated because mining regulations would not apply. This would probably reduce the biological values of those lands.

Subsidence Effects

Underground mining by continuous miners using conventional room-and-pillar methods as anticipated in all subsurface mined tracts should cause little or no subsidence at the surface (see Geology section). Any consequent changes in ephemeral channel geometry should be very minor and short-lived since these channels are continuously readjusting their size, shape, gradient, etc., to maintain approximate equilibrium with fluctuating flow conditions. Perennial channels are protected by Colorado and

Wyoming regulations that restrict mining which could materially damage a renewable resource.

Generally, any water intercepted by an underground mine would be discharged at the surface according to its National Pollutant Discharge Elimination System permit, offsetting any major impacts. Short reaches of streams could possibly be dewatered between the point of infiltration into the ground and the point of discharge because of subsurface effects of subsidence (if it occurs). The extent and probability of such occurrences would constitute an insignificant impact on a regional basis. There are areas of concern identified by the Colorado Mined Land Reclamation Board, including Middle Creek Tract (introduced under the Low alternative), Rattlesnake Mesa Tract (Moderate alternative), Peck Gulch and Fish Creek tracts (High alternative), and Bell Rock Tract (Maximum alternative), that need more hydrologic information in order to predict potential impacts from subsidence.

Water Use

Most runoff occurs during the spring snowmelt period and cannot be effectively utilized within the region in the absence of adequate storage reservoirs. Throughout the remainder of the year, virtually all flow in the four major rivers is fully appropriated and will not satisfy all existing water rights during many, if not most, years. Any increased use of water by new development under the No Action alternative, therefore, must depend on existing permitted uses that are not being fully utilized or on the transfer of current water rights from other uses such as irrigation. Maximum utilization of existing rights could further decrease river flows during critical low flow periods, but the transfer of existing rights from one consumptive use to another would not cause any decrease in flows.

As can be seen in table 4-3, projected development under the No Action alternative is estimated to increase the present (1980) consumptive use of water in the North Platte watershed by 490 acre-feet per year (ac-ft/yr), a 0.16 percent increase from the present to the year 2000. The corresponding increases in the White, Green, and Yampa watersheds could be as much as 124,200, 274,160, and 49,555 ac-ft/yr, or 142, 63, and 53 percent over 1980 total consumptive use (see tables 4-4, 4-5, and 4-6). (The increase in consumptive use of the Green River is based on projections by the Wyoming Water Development Commission in 1981.) This increased consumptive use of water by projected developments would depend on existing water rights currently not being fully utilized or on the transfer of current rights from other uses.

TABLE 4-2

NUMBER OF WELLS, SPRINGS, AND RESERVOIRS THAT COULD BE
IMPACTED AT THE ALTERNATIVE LEVELS

	Would be Removed or Replaced			Near or on Lease Tract			Water Rights
	Wells	Springs	Reservoirs	Wells	Springs	Reservoirs	
Deadman				0	0	0	0
Leucite Hills				0	3	1	0
Point of Rocks			1	3	0	1	0
Tract 98				0	0	1	0
Prairie Dog		1	1	0	1	6	0
Little Middle Creek			1	3	0	13	6
Middle Creek				0	2	15	4
Low Alternative Subtotal	0	1	3	3	6	37	10
Atlantic Rim	4	12	3	30	50	3	6
Byrne Creek				0	2	3	0
Corral Canyon				3	0	2	4
Wild Horse Draw	2	2		2	2	0	4
Rattlesnake Mesa		3		0	3	2	4
Signal Butte				0	0	4	0
Moderate Alternative Subtotal	6	18	6	38	63	51	28
Indian Springs				20	0	2	5
Pio				2	2	1	0
Winton				0	0	0	0
Peck Gulch		3	2	2	8	6	5
Hies Mountain		1	1	2	2	7	0
Fish Creek		1	1	8	4	15	11
High Alternative Subtotal	6	23	10	72	79	82	49
Northeast Cow Creek	14	3	1	17	3	1	5
Bell Rock	1			7	1	3	2
Williams Fork Mountain	1		8	3	11	40	11
Lay Creek			4	14	0	24	0
Horse Gulch	2		1	3	5	2	1
Maximum Alternative Subtotal	24	26	24	116	99	152	68

TABLE 4-3

ESTIMATED ANNUAL WATER BALANCE
FOR THE NORTH PLATTE RIVER AT ORIN, WYOMING WITHOUT LEASING NEW FEDERAL COAL

Supply, Consumption, and Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
WATER SUPPLY:					
Total undepleted water supply (ac-ft) **	1,193,400	1,193,400	1,193,400	1,193,400	1,193,400
Consumptive use:					
Riparian vegetation (ac-ft) ††	6,000	6,000	6,000	6,000	6,000
Irrigation (ac-ft) †††	---	264,600	264,600	264,600	264,600
Reservoir evaporation (ac-ft) ††††	---	41,000	41,000	41,000	41,000
Municipal and rural (ac-ft) °	---	3,250	3,230	3,320	3,540
Industrial °°° and existing mines (ac-ft) °°	---	500	600	700	700
Total consumptive use (ac-ft)	6,000	315,350	315,430	315,620	315,840
Net discharge without leasing of new Federal coal (ac-ft)	1,187,400	878,050	877,970	877,780	877,560

FOOTNOTES:

- * Existing baseline without man's use
- ** Estimated from USGS water resources data and inferred consumptive uses
- †† Does not include groundwater which is principal source of water consumed by riparian vegetation
- ††† Assumes 49,600 ac-ft used from Medicine Bow River and 215,000 ac-ft used from North Platte River
- †††† Seminoe Reservoir -35,100 ac-ft/yr; other reservoirs -5,900 ac-ft/yr
- ° Assumes consumptive use of 125 gal/day/person treated water supply of 200 gal/day/person less sewage effluent of 75 gal/day/person
- °° Most of the water consumed by existing coal mines is not a consumptive use of river water
- °°° Includes baseline projects (Chapter 2), industries such as food processing, and local services

TABLE 4-4
ESTIMATED ANNUAL WATER BALANCE
FOR THE WHITE RIVER AT THE COLORADO/UTAH STATELINE WITHOUT LEASING NEW FEDERAL COAL

Supply, Consumption, and Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
WATER SUPPLY:					
Total undepleted water supply (ac-ft) **	525,400	525,400	525,400	525,400	525,400
Consumptive use:					
Riparian vegetation (ac-ft) °°	6,800	6,800	6,000	5,600	5,100
Irrigation (ac-ft) ***	---	43,400	49,000****	49,000	49,000
Reservoir evaporation (ac-ft) °°°	---	2,600	2,600	5,890	5,890
Municipal and rural (ac-ft) °	---	920	1,810	2,290	2,110
Industrial † and existing mines (ac-ft) °°	---	33,880	107,590	121,820	149,700
Total consumptive use (ac-ft)	6,800	87,600	167,000	184,600	211,800
Net discharge without leasing new Federal coal (ac-ft)	518,600	437,800	358,400	340,800	313,600

FOOTNOTES:

* Existing baseline without man's use

** Estimated from USGS water resources data and inferred consumptive uses

*** 62,000 irrigated acres x 0.7 ac-ft water per acre (from USDA, Water and Related Land Resources of the White River)

**** 8,000 acres estimated increase from Yellow Jacket

° Assumes consumptive use of 125 gal/day/per treated water supply of 200 gal/day/person less sewage effluent of 75 gal/day/person

°° From CWCB and USDA

°°° Based on a regional study (WRC 1971)

† Includes baseline projects (Chapter 2), industries such as food processing, and local services

TABLE 4-5

ESTIMATED ANNUAL WATER BALANCE
FOR THE GREEN RIVER AT FLAMING GORGE NEAR LINWOOD, UTAH, WITHOUT LEASING NEW FEDERAL COAL

Supply, Consumption, and Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
WATER SUPPLY (ac-ft):					
Total undepleted water supply **	1,346,400	1,346,400	1,346,400	1,346,400	1,346,400
Export from basin ***	---	7,170	97,170	97,170	97,170
Consumptive use (ac-ft):					
Riparian vegetation ****	9,600	9,600	9,600	9,600	9,600
Irrigation †	---	236,800	271,900	277,400	306,900
Reservoir evaporation ††	---	106,800	106,800	106,800	106,800
Powerplants ††	---	40,700	40,700	40,700	40,700
Municipal and rural domestic use †††	---	8,770	10,750	11,100	11,200
Energy development and industry †	---	23,470	132,140	133,900	135,900
Total consumptive use and export (ac-ft)	9,600	433,310	669,060	676,670	707,470
Net discharge without leasing new Federal coal (ac-ft)	1,336,800	913,090	677,340	669,730	638,930

FOOTNOTES:

- * Existing baseline without man's use
- ** Estimated from USGS water resources at Flaming Gorge from 1924 - 1938 and inferred consumptive use (USGS Water Supply Paper 1313, p. 313)
- *** Diversion from Cheyenne Stages I, II, and III
- **** Does not include ground water which is principal source of water consumed by riparian vegetation
- † Information submitted by the Rock Springs District, BLM
- †† From p. 10 of Current and Potential Water Demands, Wyoming Water Development Commission, 1981. Reservoir evaporation includes Wyoming's share of CRSP Evaporation and Seedskadee Project
- ††† Assumes consumptive use of 125 gal/day/person by using treated water supply of 200 gal/day/person less sewage effluent of 75 gal/day/person

TABLE 4-6

ESTIMATED ANNUAL WATER BALANCE
FOR THE YAMPA RIVER NEAR MAYBELL, COLORADO WITHOUT LEASING NEW FEDERAL COAL *

Supply, Consumption, and Quality Categories	Pristine ** Conditions	Present 1980	1992	1995	2000
WATER SUPPLY:					
Total undepleted water supply *** (ac-ft)	1,135,100	1,135,100	1,135,100	1,135,100	1,135,100
Import to basin (ac-ft)	---	0	0	0	0
Export from basin (ac-ft) †	---	2,800	2,800	2,800	2,800
Consumptive use:					
Riparian vegetation **** (ac-ft)	14,900	14,900	14,900	14,900	14,900
Irrigation (ac-ft) ††	---	58,730	58,730	58,730	58,730
Reservoir evaporation ††† (ac-ft)	---	5,640	6,570	47,500††††	47,500††††
Power plants (ac-ft)	---	6,800	12,500	12,500	12,500
Municipal and rural (ac-ft) °	---	3,670	5,110	5,240	5,410
Existing mines (ac-ft) °°	---	200	455	455	455
Total consumptive use (ac-ft)	14,900	92,740	101,065	142,125	142,295
Net discharge without leasing and development of new Federal coal (ac-ft)	1,120,200	1,042,360	1,034,035	992,975	992,805

FOOTNOTES:

- * Modified from table 3-9, GR-HF FEIS
- ** Projected baseline conditions without man's use
- *** Irons and others, 1965
- **** From CWCB and USDA, 1969
- † Transbasin diversion from Bear River drainage to Egeria Creek in Colorado River basin
- †† 83,600 irrigated acres x 0.7 ac-ft water applied per acre
- ††† Estimated 1.6 feet annual loss at high elevations and 2.0 feet annual loss at lower elevations (personal communication)
- †††† Increase due to Stagecoach and Juniper reservoirs
- ° Assumes consumptive use of 125 gal/day/person. Treated water supply of 200 gal/day/person less sewage effluent of 75 gal/day/person
- °° From GR-HF FEIS

ENVIRONMENTAL CONSEQUENCES

Any appraisal of the effects of leasing new Federal coal on the available water supply in the four major regional watersheds is tenuous at best and requires a clarification of the concept of consumptive use of water in relation to established water rights. Logic dictates that any impact on the available water supply stemming from the development of new Federal coal depends not so much on the total amount of water used in the course of that development as on how much the use of that water reduces the currently available supply elsewhere in the watershed. For example, field observations show that most of the groundwater and surface water supplies on or discharging from the prospective lease tracts are currently being dissipated by evapotranspiration losses onsite or enroute downstream; the water never reaches the principal streams and rivers draining the region. Interception and use of this water in mining operations would therefore merely exchange one form of consumptive use (evapotranspiration) for another (coal development) and would not decrease the actual amount of water available for use downstream. Table 4-2 shows the number of existing on-site water rights and surface water sources in the lease areas that would require mitigation by the lessee.

To estimate the increased consumptive use of water attributable to the leasing of new Federal coal under the four leasing alternatives, it was assumed that:

1. All water consumed by the increased population would decrease flow in the respective river systems accordingly.
2. Increased consumptive use by mining would be limited to that estimated fraction of total use, based on field observations, that formerly reached a perennial stream.
3. Water obtained from aquifers more than 1,000 feet deep in the coal areas would not affect the base flow of streams within the projected mine lives and, therefore, would not be treated as increased consumptive use.

The results shown in table 4-7 should be on the high side and probably exaggerate slightly the effects of this increased consumptive use under the Maximum Leasing alternative.

Table 4-7 shows a maximum possible increased consumptive use of 1,186 acre-feet annually in the North Platte watershed under the Maximum alternative by the year 2000, which is about 0.10 percent of the total undepleted water supply. If all water consumed by new leases and the resulting population (the major consumer) were taken from the irrigation sector in the North Platte, 1,750 acres would be removed from production (BurRec 1980).

For the Green, Yampa, and White rivers, 748, 1,049, and 232 acre-feet, respectively, would be converted from other uses to support new coal leasing under the Maximum alternative. Again, if this water were all taken from the irrigation sector, 710, 1,540, and 280 acres could be removed from production from the Green, Yampa, and White rivers, respectively (WRC 1971; BurRec 1980; USDA 1966). This is not significant regionally because it represents less than one percent of the total irrigation in the region.

Urban Water Pollution

Under all alternatives, sewage effluent discharged into the North Platte River and the Yampa River by municipal sources would have the greatest effect on aquatic biology during periods of low flow when effluent dilution was minimal. The lowest flow on record in the North Platte River downstream from Sugar Creek is 70 cubic feet per second, or 50,677 ac-ft/yr. Dilution of sewage effluent at this flow would be more than adequate to prevent any significant degradation of the aquatic biology downstream.

Results of a study on the wastewater assimilative capacity of the Yampa River between Steamboat Springs and Hayden during September 1975 (Bauer, Steel, and Anderson 1978) indicate that pollutants that could degrade aquatic biology would be mitigated by completion of regional wastewater treatment plants in the Steamboat Springs and Craig areas. The Steamboat Springs plant has been completed; the Craig plant is currently under construction.

Extensive urban growth in the Green and White River watersheds would eventually exceed current wastewater treatment plant capacities. Plants would require upgrading to comply with the Clean Water Act. However, by about 1995 under both the No Action and four leasing alternatives, Meeker could have problems financing a new wastewater treatment plant. South Superior in Wyoming would also have a potential financing problem in 1995 under the High and Maximum alternatives. These towns would have to seek outside sources for funds, e.g., energy impact assistance, to meet wastewater treatment requirements.

Pollutants in wastes are minimized by effluent standards enforced by the Wyoming Department of Environmental Quality and the Colorado Department of Health through National Pollutant Discharge Elimination System permits.

The extent of degradation in water quality in the reaches downstream from urban growth due to new leases in the major rivers has not been quantified.

TABLE 4-7

SUMMARY MATRIX OF ANNUAL WATER BALANCE AND WATER QUALITY
AT MAXIMUM DEVELOPMENT AT THE YEAR 2000

	North Platte River			Green River			Yampa River			White River		
	A *	Total **	Percent †	A *	Total **	Percent †	A *	Total **	Percent †	A *	Total **	Percent †
WATER SUPPLY:												
Total Undepleted Water Supply (ac-ft) ††		1,193,400			1,346,400			1,135,100			525,400	
Consumptive Use:												
Municipal and rural (ac-ft)	1,086	4,626	23.	598	11,798	5.1	649	6,059	11.	182	2,292	7.9
Mines, Industry, and power plants (ac-ft) *	100	800	12.	150	176,750	.08	400	13,355	3.0	50	149,750	.03
All other Consumptive Use: †† (ac-ft)		311,600			519,670			123,930			59,990	
Total Consumptive Use (cumulative impact)	1,186	317,026	.37	748	708,218	.11	1,049	143,344	.73	232	212,032	.11
Net discharge with leasing new Federal Coal (ac-ft)		876,374			638,182			991,756			313,368	
SALT LOAD:												
Sources of Salt:†††												
Municipal Waste (tons)	296	7,186	4.1	163	1,993	8.2	177	1,057	17.	50	390	13.
Mines and Industry (tons) **	192	542	35.	185	2,635	7.0	506	2,241	22.	0	630	0.0
All other sources †† (tons)		328,250			964,380			268,705			245,700	
Reduction in Salt Load From:												
Consumptive use of water by people (tons)	-443	-1,883	23.	-244	-2,914	8.4	-265	-1,565	17.	-74	-936	7.9
Consumptive use of water by mines, Industry & power plants (tons)	-41	-331	12.	-61	-72,431	.08	-163	-3,328	4.9	-20	-66,570	.03
All other consumptive use of water †† (tons)		-3,820			-16,530			-480				
Total Salt Load (tons (cumulative impact)	4	329,944	0.0	43	883,993	0.0	255	266,630	.10	-44	179,217	.02
Discharge weighted average dissolved solids mg/L		276.63			1,017.76			197.54			420.21	
Net Increase in dissolved solids with leasing new Federal Coal (mg/L)		.38	.14		1.76	.17		.40	.51		.21	.05

FOOTNOTES:

* A is change exclusively due to leasing and development of new Federal coal

** TOTAL is total estimated quantity with leasing and development of new Federal coal

† Percent is a percentage of what part the A makes up the TOTAL

†† From Tables 4-3, 4-4, 4-5, 4-6

* Estimated at 50 ac-ft per year for new mines

** Estimated from a salt load study (EFC 1980) and projected surface disturbance

††† From Tables 4-8, 4-9, 4-10, 4-11

ENVIRONMENTAL CONSEQUENCES

However, any impacts on aquatic biology are expected to be minimal and short term due to state discharge regulations requiring wastewater treatment plants.

Salt Loading

Development under the No Action alternative is expected to increase the salinity of receiving waters because of increased salt loading (also expressed as total dissolved solids, or TDS) from municipal and industrial wastes, mine effluent, and leaching of spoils, and from the salt concentrating effects of the consumptive use of good quality water that formerly diluted poorer quality water entering the surface water system downstream. The following discussion includes surface water and groundwater contributions to salinity downstream. Individual groundwater contributions are discussed later.

Projected development under No Action can be expected to increase the salinity of receiving waters downstream in the four major rivers (discussed below), with a subsequent increase in the lower Colorado River at Imperial Dam to 962 mg/l by the year 2000 (BLM 1983). Water normally becomes unusable for certain crops when total dissolved solid levels exceed 1,000 milligrams per liter (mg/l) (EPA 1976).

Salinity in the North Platte River under the No Action alternative would increase about 1 percent from the present level of about 273 mg/l dissolved solids (table 4-8) to a maximum of about 276 mg/l over the long term. Water containing this much salt is suitable for all current downstream uses, so no problems are anticipated.

Salinity in the Yampa River under No Action would increase about 5 percent from the present level of about 188 mg/l to a maximum of about 197 mg/l over the long term (table 4-9). This water would be suitable for all current uses.

Salinity in the Green River would increase about 52 percent from the present level of about 667 mg/l to a maximum of about 1,016 mg/l over the long term (table 4-10). A large portion of this increase is attributable to high projected baseline agricultural use in the Green River basin (Wyoming Water Development Commission). Saline water of this level would be limited to livestock, and certain crops and industrial uses.

Table 4-11 shows salinity in the White River would increase about 7 percent under the No Action alternative from the present level of about 392 mg/l to a maximum of about 420 mg/l over the long term, which would be acceptable for most uses.

In analyzing the Maximum alternative, it was assumed that any change in discharge or salt loading upstream would cause an identical change downstream. The results, therefore, should be regarded as reflecting a "worst-case" condition.

A depletion of 2,030 ac-ft/yr in the Colorado River basin is expected under the Maximum alternative because of increased consumptive use. This does not represent a significant problem; however, when combined with other factors such as urban pollution, mine effluent, and leaching of spoil piles, water depletion represents a significant impact relative to standards set by the Federal Water Pollution Control Act Amendments of 1972. The above cumulative impact would result in a 0.06 mg/l increase in salinity at Imperial Dam, California, based on modeling using the Colorado River Basin Simulation System. Although this is a small increase, it is significant because it occurs in a system that is already salt-laden. (This is the salinity increase associated with maximum level of development. Water uses with the other leasing alternatives would be so small that they exceed computational accuracy of the equation used to calculate salinity.)

On completion of mining, groundwater discharge would resume once the spoils had resaturated to a level higher than the adjacent streams. Considerable uncertainty exists as to both the amount of postmining discharge from each mine area and the dissolved solids concentration in the water reaching the streams. The increase in dissolved solids concentrations during low flow for the various streams with development of new Federal coal is shown in table 4-7.

Even with the cumulative effect of salt loading, most rivers are predicted to be usable for existing uses under the Maximum alternative. The one exception would be the Green River, which would no longer be suitable for certain crops and other high quality uses.

The water requirements necessary to support additional coal leases and associated urbanization under the four leasing alternatives would be virtually unnoticed downstream in the Colorado River system because of dilution from other rivers. Even the small increase in salinity that is calculated to occur under the Maximum alternative (.06 mg/L) may be beyond the accuracy of the equation used.

The fact that the increase in salt loading is not measurable in a large river system does not mean that salt loading would be insignificant in a smaller system. Two streams of critical concern, Fish and Trout creeks, drain much smaller watersheds, have ongoing coal mining operations within their watersheds, and are in an area where increased land disturbance is planned and geologic conditions pro-

TABLE 4-8

ESTIMATED WATER QUALITY FOR THE
NORTH PLATTE RIVER WITHOUT LEASING NEW FEDERAL COAL °

Supply, Consumption, and Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
SALT LOAD:					
Sources of salt:					
Natural sources (tons/year) °°	250,000	250,000	250,000	250,000	250,000
Irrigation (tons/year)	---	70,610	70,610	70,610	70,610
Municipal wastes (tons/year) °°°	---	6,330	6,280	6,460	6,890
Industrial and existing mines (tons/year) °°°°	---	250	300	350	350
Import to basin (tons/year) #	---	2,180	7,640	7,640	7,640
Reduction in salt load from:					
Export of water from basin (tons/year) ##	---	-1,090	-3,820	-3,820	-3,820
Consumptive use of water by people (tons/year) ###	---	-1,330	-1,320	-1,360	-1,440
Consumptive use of water by industry and mines (tons/year) ###	---	-200	-240	-290	-290
Total salt load in North Platte River (tons/year)	250,000	326,750	329,450	329,590	329,940
Discharge weighted average dissolved solids in North Platte River at Seminoe Reservoir (mg/l)	155	273 ####	276	276	276

FOOTNOTES:

- ° Modified from Green River-Hams Fork FEIS Round 1, table 3-8
- °° Estimate based on dissolved solids concentration during spring runoff at USGS gaging stations, when salt load from other sources is proportionately small
- °°° Based on 75 gal/day/person and increase in dissolved solids concentration of 200 mg/l
- °°°° Estimated from a salt load study (EFC 1980) and projected surface disturbance
- # Based on dissolved solids concentration of 200 mg/l
- ## Based on dissolved solids concentration of 100 mg/l
- ### Based on dissolved solids concentration of 300 mg/l
- #### Base on weighted average dissolved solids concentration of inflow to Seminoe Reservoir from North Platte and Medicine Bow Rivers and from Big Ditch

TABLE 4-9

ESTIMATED WATER QUALITY
FOR THE YAMPA RIVER WITHOUT LEASING NEW FEDERAL COAL *

Supply, Consumption, and Quality Categories	Pristine ** Conditions	Present 1980	1992	1995	2000
SALT LOAD:					
Sources of Salt:					
Natural sources (tons/year)***	171,800	171,800	171,800	171,800	171,800
Irrigation and dryland farming (tons/year) °	---	96,905	96,905	96,905	96,905
Municipal wastes (tons/year) °°	---	600	835	860	880
Existing mines (tons/year) #	---	1,090	1,365	1,370	1,735
Reduction in salt load from:					
Export of water from basin (tons/year) ##	---	-480	-480	-480	-480
Consumptive use of water by power plants (tons/year) ###	---	-1,620	-2,980	-2,980	-2,980
Consumptive use of water by people (tons/year) ###	---	-870	-1,220	-1,250	-1,300
Consumptive use of water by mining (tons/year) ####	---	-80	-185	-185	-185
Total salt load in Yampa River (tons/year)	171,800	267,345	266,040	266,040	266,375
Discharge weighted average dissolved solids in Yampa River at Maybell (mg/l)	113	188	189	197	197

FOOTNOTES:

- * Modified from table 3-9, Green River-Hams Fork FEIS Round 1
- ** Projected baseline conditions without man's use
- *** Estimate based on dissolved solid concentration during spring runoff at USGS gaging station when salt load from other sources is proportionately small
- ° Estimated average dissolved solids loadings contributed by irrigation from WRC (1971) (Coef = 1.65 tons/irr ac/yr)
- °° Based on 75 gal/osn sewage/day/person and increase in dissolved solid concentration of 200 mg/l
- # Estimated from a salt load study (EFC 1980) and projected surface disturbance
- ## Based on dissolved solids concentration of 125 mg/l
- ### Based on dissolved solids concentration of 175 mg/l
- #### Based on dissolved solids concentration of 300 mg/l

TABLE 4-10

ESTIMATED WATER QUALITY
FOR THE GREEN RIVER WITHOUT LEASING NEW FEDERAL COAL

Supply, Consumption, and Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
SALT LOAD:					
Sources of Salt:					
Natural sources (tons/year) †	458,000	458,000	458,000	458,000	458,000
Irrigation (tons/year) °	---	390,720	448,630	457,710	506,380
Municipal waste (tons/year) °°	---	1,430	1,750	1,810	1,830
Existing mines (tons/year) °°°	---	490	860	810	880
Other energy development and industry °°°° (tons/year)	---	1,100	1,500	1,510	1,570
Reduction in salt load from:					
Export of water from basin (tons/year) #	---	-1,220	-16,530	-16,530	-16,530
Consumptive use of water by power plants (tons/year) ##	---	-9,690	-9,690	-9,690	-9,670
Consumptive use of water by people (tons/year) ##	---	-2,090	-2,560	-2,640	-2,670
Consumptive use of water by coal mining (tons/year) ###	---	-200	-300	-330	-350
Consumptive use of water by energy and industry (tons/year) ###	---	-9,580	-53,950	-54,670	-55,490
Total salt load in Green River (tons/year)	458,000	828,970	827,710	835,980	883,750
Discharge weighted average dissolved solids in Green River at Flaming Gorge, Wyoming (mg/l)	248	667	899	942	1,016

FOOTNOTES:

SOURCE: Wyoming Water Development Commission

* Existing baseline without man's use

† Estimate based on dissolved solids concentration during spring runoff when salt load from other sources is proportionately small

° Estimated average dissolved solids loadings contributed by irrigation of 12 inches of water per acre (Coef = 1.65 ton/irr ac/yr) (WRC 1971, Appendix XV, p. 55)

°° Based on 75 gal/day/person and increase in dissolved solids concentration of 200 mg/l

°°° Estimated from a salt load study (EFC 1980) and projected surface disturbance

°°°° Based on a regional study (WRC 1971)

Based on a dissolved solids concentration of 125 mg/l

Based on a dissolved solids concentration of 175 mg/l

Based on a dissolved solids concentration of 300 mg/l

TABLE 4-11
ESTIMATED WATER QUALITY
FOR THE WHITE RIVER WITHOUT LEASING NEW FEDERAL COAL

Quality Categories	Pristine * Conditions	Present 1980	1992	1995	2000
SALT LOAD:					
Sources of salt:					
Natural sources (tons/year) †	163,000	163,000	163,000	163,000	163,000
Irrigation (tons/year) ††	---	86,000	84,100	83,600	82,700
Municipal wastes (tons/year) †††	---	150	300	370	340
Industrial (tons/year) ††††	---	140	270	340	310
Existing mines (tons/year) °	---	190	280	300	320
Reduction in salt load from:					
Export of water from basin (tons/year)	---	0	0	0	0
Consumptive use of water by people (tons/year) °°	---	-376	-739	-935	-862
Consumptive use of water by industry and mines (tons/year) °°	---	-15,270	-45,730	-53,080	-66,550
Total salt load in White River (tons/year)	163,000	233,834	201,481	193,595	179,258
Discharge weighted average dissolved solids in White River (mg/l)	231	392	413	417	420

FOOTNOTES:

- * Existing baseline without man's use
- † Estimate based on dissolved solid concentration (= .31 tons per ac-ft) when salt load from other sources is proportionately small
- †† Estimated Average Dissolved Solids Loadings Contributed by Irrigation from WRC (1971) (Coef = 1.65 ton irr ac/yr)
- ††† Based on 75 gal sewage/day/person and an increase in dissolved solids concentration of 200 mg/l
- †††† Based on a regional study (WRC 1971)
- ° Estimated from a salt load study (ECC 1980) and projected surface disturbance
- °° Based on a dissolved solids concentration of 300 mg/l

ENVIRONMENTAL CONSEQUENCES

mote naturally high total dissolved solids concentrations. Due to these factors, salt loading to these two streams would be significant.

Middle Creek and Little Middle Creek tracts (introduced under the Low alternative) and the Fish Creek Tract (High alternative) are in the watersheds of critical concern to Trout and Fish creeks. The Kaman Tempo Report (1982), prepared for the Office of Surface Mining, specifically studied the effects of coal mining on these two creeks. It is noted that "the elevated TDS (total dissolved solids) concentrations in the Yampa River during low flow and in Fish Creek may have an adverse impact on agricultural uses of water from these drainages."

The Fish Creek groundwater system may have already reached its threshold of material damage from present mines during low flow conditions (personal communication, MLRB 1983). It is probable that development of new leases would aggravate the existing problem. No proven, economical mitigation is known to date. Trout Creek is a concern because the geology and hydrologic characteristics are similar, there are existing and proposed mines in the watershed, and Fish Creek is a tributary of Trout Creek.

The possibility exists, as continued coal development takes place, that total dissolved solids concentrations would increase in and around all of the coal lease tracts. The degree to which these concentrations would increase and the impacts which would result cannot be determined at this time. However, it can be said that total dissolved solids levels are not expected to increase as much regionwide as in Fish and Trout creeks. At the present time, no other coal lease tracts have been specifically identified as being in a watershed with all the characteristics of the two critical streams.

Sediment Yield

The greatest portion of sediment load in streams in the EIS region is derived naturally from the more arid lower elevations. Vegetation cover begins to be sparse in areas with less than 10 inches of total precipitation. Friable streambank soil types, coupled with poor range condition, improper land use, and lack of protective vegetation cover, would account for the high sediment yields under the No Action alternative that would continue to characterize some of the streams in the major river drainages at lower elevations.

The proposed developments under No Action could add as much as 3,900 tons per year due to surface disturbance to the North Platte sediment discharge by the year 2000. Likewise, 12,300, 7,400, and 9,400 tons per year could be added to

the Green, Yampa, and White rivers, respectively, by the year 2000. Compared to present values, these sediment yields would be insignificant.

Changes in sediment yield stemming from disturbances directly and indirectly associated with coal development under the leasing alternatives would range widely, depending on required mitigation measures and proximity to perennial streams. Runoff from areas disturbed by surface activities associated with surface or underground mining must not transport offsite more than 30 mg/l total suspended solids as an average daily value for 30 consecutive discharge days (Federal and state regulations).

However discharges for less than 30 days can exceed 30 mg/l, and occurrence of this is frequent. Another factor, which is less predictable, is the probability of a storm event exceeding the design criteria of sediment ponds (10-year, 24-hour). If this occurred, a pond could discharge water having sediment exceeding 30 mg/l. Another major source of sediment would be haul roads that are exempt under current regulations.

Conditions could exist that naturally mitigated excessive sedimentation, such as nearly level slopes and roads, deposition of sediment before reaching a perennial stream, or good fortune in not having a major storm during the life of a mine. Overdesign of sediment control structures to handle expected storms during the life of a mine would also help.

To quantify changes in sediment yield from the leasing and development of new Federal coal is very difficult with available information. Sediment yield rates could remain the same or increase as much as 50 percent. Assuming a 25 percent increase for purposes of analysis, an approximation of sediment yield by the year 2000 is shown in table 4-12. There would be a period of time when sediment yield would exceed premining rates; however, as sediment and runoff control devices were established as outlined in state regulations, sediment yields would possibly decrease.

These inferred changes in annual sediment yield are insignificant compared to annual sediment load of the Green, North Platte, White, and Yampa rivers. Thus, any impacts from changes in erosion and sediment yield over the period of mining should be very local, short-lived, and difficult to measure.

On completion of mining and reclamation and removal of sedimentation ponds, sediment yields from most reclaimed areas are expected to return to approximate predisturbance rates. The notable exceptions would be urbanized areas, which should remain stable over the long term, and possibly the steeper slopes on some of the tracts, which could be difficult to stabilize if the original contour was

TABLE 4-12

SEDIMENT YIELD AT THE YEAR 2000

Alternative	River Basin	Acres Disturbed			Suspended Sediment * Ton/ac/yr.	On-Site**	Off-Site †	Net Yield	River Basin Yield			
		On-Site	Off-Site	Infra-Structure ††					N. Platte	Green	Yampa	White
Deadman	Green	80	---	--	.11	11	--	11		11		
Leucite Hills	Green	3,600	67	36	.11	495	11	506		506		
Point of Rocks	Green	2,780	20	18	.11	382	3	385		385		
Tract 98	Green	164	---	--	.11	23	--	23		23		
Prairie Dog	White	40	110	55	.42	21	69	90				90
Little Middle Creek	Yampa	700	---	--	.30	263	--	263			263	
Middle Creek	Yampa	10	---	4	.30	4	--	4			4	
Low Alternative Subtotal		6,430	197	113					--	925	267	90
Atlantic Rim	.5 Platte	7,110	770	160	.03	1,466	191	1,657				
	.5 Yampa				.30							
Byrne Creek	Green	2,230	30	36	.11	307	5	312		312		
Corral Creek	Platte	2,272	375	93	.03	85	17	102	102			
Wild Horse Draw	Platte	945	575	75	.03	35	26	61	61			
Rattlesnake	White	40	40	47	.42	21	25	46				46
Signal Butte	Yampa	1,082	318	29	.30	406	143	549			549	
Moderate Alternative Subtotal		20,109	2,305	553					163	1,237	816	136
Indian Springs	Platte	100	100	69	.03	4	5	9	9			
Pio	Green	2,680	284	36	.11	369	47	416		416		
Winton	Green	43	62	239	.11	6	10	16		16		
Peck Gulch	Yampa	40	80	81	.30	15	36	51			51	
Hies Mountain	Yampa	1,100	80	40	.30	413	36	449			449	
Fish Creek	Yampa	300	25	65	.30	113	11	124			124	
High Alternative Subtotal		24,292	2,936						172	1,669	1,440	136
Northeast Cow Creek	Yampa	40	420	226	.30	15	189	204			204	
Bell Rock	Yampa	50	45	66	.30	19	20	39			39	
Williams Fork Mountain	Yampa	3,917	65	30	.30	1,469	29	1,498			1,498	
Lay Creek	Yampa	2,066	385	45	.30	775	173	948			948	
Horse Gulch	Yampa	1,143	100	13	.30	429	45	474			474	
Maximum Alternative Subtotal		33,241	3,951	1,463					172	1,669	4,603	136
Percent of Present Yield									.03%	.24%	.70%	0%

FOOTNOTES:

* Values taken from Chapter 3

** Sediment yield increased to 25% premining levels.

† Off-site disturbance would double yield for 1st two years then 1.5 x sediment rate

†† Infrastructure sediment yield would double for 1st two years then return to premine rate

ENVIRONMENTAL CONSEQUENCES

approximately restored as required by state regulations.

At this time, it is not known whether steep slopes could be returned to their present erosional stability. Successful rehabilitation of steep slopes would depend on the reconstruction of stable channels and the reestablishment of deep-rooted woody plants with a grass understory that is at least comparable to the existing cover. If that stability was not achieved, sediment yield from those areas could increase above the premining rate.

Byrne Creek Tract (Moderate alternative) has an identified sediment yield problem that would constitute a significant onsite impact. Details can be found in the site specific analysis located at the Rock Springs BLM District Office.

Groundwater

Projected mining under the No Action alternative would result in the removal of certain aquifers in disturbed areas, which would cause localized disruption of existing wells and springs and future groundwater development in the affected areas. There would be no significant effect on regional groundwater.

Impacts to the groundwater resources in both the Colorado and Wyoming areas as a result of leasing and development of new Federal coal would occur almost entirely in the vicinity of the mined areas and should have no significant effect on regional groundwater systems, either alone or in combination with baseline development. (One localized area described later may have impacts due to a high concentration of existing and proposed mines.) Local impacts would stem from or occur to:

1. Aquifer removal--extraction of source areas for springs and wells
2. Interruption of groundwater flow--modification of premining groundwater flow in mined areas
3. Spoil pile groundwater movement--a change in groundwater flow due to replaced spoil material
4. Water quality--changes in water quality caused by leaching of spoil materials and by mixing of water between aquifers not interconnected before mining
5. Subsidence--possible changes in groundwater due to subsidence and/or fracturing of overlying rocks from underground mining

Aquifer Removal

Leasing and mining new Federal coal under the leasing alternatives would unavoidably result in the local removal of parts of certain aquifers within the mined areas, with consequent impacts on existing wells and springs and on future groundwater development in the affected areas. Aquifers adversely affected by surface mining would include the mined coal beds, all saturated beds and lenses of permeable sandstone in the overburden and interburden, and alluvial aquifers. Underground mining would remove only the mined coal beds.

Development of the Atlantic Rim Tract could significantly affect the hydrology of Separation Creek in Wyoming (Site Specific Analysis 1983). Wildlife habitat types, such as riparian and aspen, are dependent on moisture provided by the springs. If some of the spring inflows were destroyed or diminished, these habitat types would be difficult to replace during reclamation.

The approximate size of the aquifers that would be removed during the time frames addressed in this EIS and the relationship of the affected areas to the total area of the respective watersheds are summarized in table 4-13. Aquifers removed may or may not be confined, depending on the existence of confining layers of tract and distance from recharge areas. Table 4-13 shows that, under the Maximum alternative, a cumulative total of 13,800 acres of aquifers (0.0026 percent of the watersheds) would be removed and replaced in Wyoming by end of mine life, whereas 25,600 acres (0.0167 percent of the watersheds) would be removed and replaced in Colorado.

Those parts of the coal and overlying aquifers that were removed by surface mining would be replaced by a single aquifer comprised of broken spoil materials. Because of the preponderance of sandstone in the coal-bearing formations in both Wyoming and Colorado, the spoil materials should be moderately permeable unless they were compacted during final placement. All replaced spoil aquifers, therefore, should have at least as much capacity to store and transmit groundwater as the original aquifers, once they are resaturated. However, resaturation could take 50 to 100 years after completion of mining.

Those parts of the coal aquifers that were removed by underground mining would not be replaced. Subsequent collapse of pillars or roof collapse would leave a rubble zone that should include interconnected voids for a period of many decades. If penetrated below the top of the saturated zone, these permeable rubble zones should yield adequate supplies of water to wells for use by livestock and wildlife. The quality of the water thus

TABLE 4-13

REMOVAL OF AQUIFERS BY LEASING NEW FEDERAL COAL
AT MAXIMUM DEVELOPMENT (END OF MINE LIFE)

	Type of Mine	Water Bearing Zones *	Acres Removed **	North Platte ††		Green River †††		Yampa River °		White River **	
				Acres	Percent	Acres	Percent	Acres	Percent	Acres	Percent
Deadman	Surface	Ft. Union, Lance	75			75	.0000				
Leucite Hills	Surface	Alluvial, Ft. Union, Lance	1,200			1,200	.0002				
Point of Rocks	Surface	Alluvial, Almond	1,150			1,150	.0002				
Tract 98	Surface	Adaville, Hillard shale	164			164	.0000				
Prairie Dog	Underground †	Alluvial, Williams Fork	11,518							11,518	.0072
Little Middle Creek	Surface	Twenty Mile, Trout Creek	676					676	.0001		
Middle Creek	Underground	AVF***, Alluvial, Iles	1,040					1,040	.0002		
Low Alternative Subtotal				0	0	2,589	.0004	1,716	.0004	11,518	.0072
Atlantic Rim	Surface	AVF, Alluvial, Almond, Pine Ridge	7,110***	3,555	.0008			3,555	.0008		
Byrne Creek	Surface	AVF, Alluvial, Adaville, Lazaert	900			900	.0001				
Corral Canyon	Surface	Alluvial, Almond	2,272	2,272	.0007						
Wild Horse Draw	Surface	Alluvial, Almond	945	945	.0003						
Rattlesnake Mesa	Underground	AVF, Alluvial, Williams Fork	936							936	.0006
Signal Butte	Surface & Underground	Twenty Mile, Trout Creek	783					783	.0002		
Moderate Alternative Subtotal				6,772	.0018	3,489	.0005	6,054	.0014	12,454	.0078
Indian Springs	In situ Gasification	Ft. Union, Lance	2,436***								
Pio		Almond, Lewis	950			950	.0001				
Winton	Underground	Alluvial, Ericson, Rock Springs	6,161			6,161	.0009				
Peck Gulch	Underground	AVF, Alluvial, Twenty Mile, Trout Ck.	1,923					1,923	.0004		
Iles Mountain	Surface	Alluvial, Twenty Mile	750					750	.0002		
Fish Creek	Surface & Underground	AVF, Alluvial, Twenty Mile, Trout Ck.	200					200	.0000		
High Alternative Subtotal				6,772	.0018	10,600	.0016	8,927	.0020	12,454	.0078
Northeast Cow Creek	Underground	AVF, Alluvial, Almond	8,323***					8,323	.0020		
Bell Rock	Underground	AVF, Trout Creek, Twenty Mile	1,712					1,712	.0004		
Williams Fork Mountain	Surface	AVF, Alluvial, Twenty Mile	3,525					3,525	.0008		
Lay Creek	Surface	AVF, Alluvial, Ft. Union	1,650					1,650	.0004		
Horse Gulch	Surface	AVF, Alluvial, Lewis, Twenty Mile	909					909	.0002		
Maximum Alternative Subtotal				6,772	.0018	10,600	.0016	25,047	.0055	12,454	.0078

FOOTNOTES:

* See tables 3-10 and 3-11 for aquifer characteristics.

** Refers to the surface area from which aquifers are removed. For example, removal of several aquifers from a mined area of 50 acres is reported as an area of 50 acres of aquifers removed. See text for spoil pile replacement.

*** Alluvial valley floors (AVF's) have been identified in the Land Use plans. See SSAs for application of unsuitability criteria details.

† It is assumed that underground mines will remove coal from the entire lease acreage.

†† Area of watershed 7,230 square miles.

††† Area of watershed 15,090 square miles.

° Area of watershed 7,140 square miles.

°° Area of watershed 3,680 square miles.

°°° Located in the Great Divide and Washakie Basins at an area of 6,100 square miles.

ENVIRONMENTAL CONSEQUENCES

obtained should not be significantly different from water which occurred in the coal aquifers prior to mining. Most existing wells, however, obtain their water from sandstone beds in the coal sequence. The occurrence of groundwater in these sandstone aquifers should return to essentially premining conditions following the completion of mining and reestablishment of hydrologic equilibrium in the mined areas.

The number of wells and springs that would probably be destroyed or seriously depleted under the four leasing alternatives is listed in table 4-2. Under the Maximum Leasing alternative, only 20 wells and 17 springs in Wyoming and 4 wells and 8 springs in Colorado would be severely depleted or destroyed. Adjacent wells listed in table 4-2 may receive minor impacts, such as lower water levels or decreased water quality.

In all cases, new wells could be completed on the postmining surface, although their depth and pumping lift is expected to be several hundred feet greater than under present conditions. Most impacted springs would probably be permanently impaired. Although new, possibly larger springs should occur lower on the slopes in most cases in the long term, this resaturation of the spoils aquifers could take 50 to 100 years. However, impacts to groundwater supplies should be very local and consist principally of increased drilling and pumping costs.

Interruption of Groundwater Flow

Water pumped from both surface and underground mines would create a local cone of drawdown or low point in the groundwater flow system. The effect would be to interrupt groundwater movement through the mine areas towards natural discharge areas, usually the nearest incised valley holding a perennial or intermittent stream. As a result, water levels in the affected aquifers would be lowered in the vicinity of the mines. Additional lowering of water levels would occur in the vicinity of those mines where wells tapping these same aquifers were pumped to supply water for mining operations.

The magnitude of water level declines in the vicinity of the mines would depend on aquifer properties, recharge characteristics, rate of pumping, and duration of pumping, but declines would probably not exceed 100 feet within the mined areas and should not greatly exceed 10 feet more than a mile from the mined areas. If any nearby domestic or stockwater wells were significantly impacted, the responsible mining company would have to replace the interrupted supplies (Colorado and Wyoming regulations).

Dewatering of those mines that extend below the level of nearby perennial or intermittent streams could cause a reversal of the hydraulic gradient in the immediate vicinity of all subsurface tracts. Water would then tend to move from the streams toward the mines instead of from the mine areas toward the streams, as is currently happening. A reduction in streamflow could result, but the magnitude should be small and should not materially impact any of the perennial streams in the EIS area because of regulatory requirements. As renewable resources, perennial streams and alluvial valley floors would be protected by state regulations. Impacts to intermittent streams would be alleviated when mined out areas became saturated and the hydraulic gradient returned.

Spoil Pile Groundwater Movement

Relatively impermeable shale interbedded with sandstone and coal gives rise to perched groundwater conditions in most, if not all, of the coal areas under consideration in both Wyoming and Colorado. Removal of these perching layers and replacement of the mined interval in surface mined areas with spoil materials that should have much higher vertical permeability than the premining stratigraphic sequence would largely eliminate this groundwater perching. The effect would be to reduce the amount of groundwater moving laterally on top of perching layers toward discharge areas along nearby valley side slopes and to increase groundwater recharge to depth. As a result, vegetation along the valley side slopes would be locally deprived of most or all of this additional moisture and would have to readjust accordingly in vigor, density, and type. Increased groundwater recharge to depth would cause increased leaching of spoil materials and eventual transport over the long term of at least a part of these leached materials into the surface water system, contributing to the salinity of downstream waters as previously mentioned in the Salt Loading section under Surface Water in this chapter.

Changes stemming from modification of flow by replaced spoil materials should be largely local in aspect and cannot be quantified in the absence of specific mine plans and adequate data defining local groundwater occurrence. It is important to note, however, that the effects should be minor during the period of active mining in each tract and should become locally significant only after completion of mining and reclamation. These impacts would then continue over the long term.

ENVIRONMENTAL CONSEQUENCES

Water Quality

As water entering at the surface or from aquifers truncated by mining operations percolates through replaced spoil materials, solution and interaction with soluble minerals in the spoils are expected to significantly degrade the quality of the local groundwater resource.

The existing groundwater quality of the Northeast Cow Creek Tract (introduced under the Maximum alternative) would pose special problems resulting from pressurized flammable gas dissolved in the groundwater. The water under artesian pressure and the methane gas could pose serious hazards to mining, especially underground mining. Presumably, additional testing of the hydraulic characteristics and gas content would be done before mining began.

The Indian Springs Tract (High alternative) the only in situ coal gasification project, has the potential of polluting adjacent aquifers with toxic organic by-products. It could also alter hydrologic characteristics of substrata.

Impacts onsite and offsite from leaching of spoils aquifers could be minimized by selective placement and compaction of backfilled materials so as to retard recharge to the spoils aquifer from surface infiltration and from adjacent truncated aquifers. Other regulations however, seem to preclude this approach by requiring that reclaimed areas be restored to approximate premining recharge capacity so as to minimize disturbances to the prevailing hydrologic balance, both onsite and offsite. If premining recharge capacity is restored in a mined area, then it follows that a corresponding amount of discharge must occur from the spoils aquifer so that discharge equals recharge over the long term. Discharge may occur as obvious springs and seeps, as less obvious contribution to adjacent streams, as movement into those truncated aquifers down gradient that have lower head or confining pressures, as transpiration losses, or as pumpage from wells.

Where discharge is to a nearby perennial stream, the increased salt load from leaching of the spoils aquifer could be significant and may contribute directly to salinity problems downstream.

Where discharge from a spoils aquifer is indirect to the upper reaches of an ephemeral stream miles from its confluence with a perennial stream or river, it may take decades or even centuries before any effects are felt downstream. This is especially true when the premining dissolved solids concentration of underflow in the alluvium underlying the stream approaches that of the expected leachate from the spoils aquifer.

Much less is known about the long-term effects of the movement of salts leached from reclaimed spoils aquifers into adjacent undisturbed parts of the coal and any permeable overlying rocks. Movement of the leachate would occur only down the slope of the hydraulic gradient, which is usually downdip from a mined area. The rate of movement of this polluting front is typically only a few inches or, at most, a few feet per year. A significant reduction in dissolved solids concentrations can be expected with increasing distance from the mined area because of salt sieving as a result of the selective retention of ions on particle surfaces (Riffenburg 1925; Qayyum and Kemper 1962). Thus, degradation of water quality in areas adjacent to reclaimed spoils is expected to be a slow process, requiring centuries to become significant more than a few hundred feet from reclaimed mine areas.

Aquifers that were not hydraulically connected before mining and which were truncated by mining below the top of the saturated zone would be connected through the resaturated mine fill after mining and reclamation. Compaction of the fill around the periphery of the mined area would minimize circulation between such aquifers, but premining head differences between aquifers would probably be largely eliminated. Local changes in hydraulic gradients, however, would probably be insignificant when considering the total aquifer system.

Subsidence

Subsidence both during and following the completion of underground mining could introduce shear stresses in the overlying rocks that could eventually cause local rupture within all subsurface tracts. Cracks thus formed commonly extend upward to the surface and would open all intersected aquifers to intercirculation of groundwater and equalization of pressures. Upper perched zones could be drained, adversely impacting a few stock-water and domestic wells. Mixing of waters could slightly degrade water quality in the deeper aquifers within and immediately adjacent to these tracts, but no existing water supplies should be affected. Equalization of pressures could extend as much as a mile outside the tracts, but again, no existing water supplies should be significantly impacted. Such impacts, although minor, would be long term.

Alluvial Valley Floors

During land use planning, unsuitability criterion 19 was applied to all tracts, and Fish Creek was the only stream to be determined unsuitable for coal

ENVIRONMENTAL CONSEQUENCES

development. (see Appendix 2 for applicable mitigation). No coal development would be precluded by the unsuitable Fish Creek alluvial valley floor on tract. It is not known what impacts would occur to the Fish Creek alluvial valley floor off tract because the mining sequence cannot be predicted. In addition, a total of 14 alluvial stream deposits were identified (see Table 4-14), but sufficient information was not available to determine whether they are alluvial valley floors which will need protection. This determination will be made at the mine plan stage. If it is determined during mining plan review that the 14 potential alluvial valley floors and the off-tract Fish Creek alluvial valley floor should be protected, the amount of coal foregone is unknown.

Flood Plains

During land use planning, unsuitability criterion 16 was applied to all tracts and 15 floodplains were found unsuitable for coal development because of substantial threats (1) of loss to people or property and (2) to the natural and beneficial values of the floodplain. A total of 29 flood plains were determined to be suitable for coal development. Table 4-14 portrays which tracts contain flood plains. Coal would be foregone in the Horse Gulch Tract (1.5 million tons) and the Williams Fork Tract (1.06 million tons). The amount of coal foregone on the other tracts because of flood plains unsuitable for coal development is not known. However, a general analysis indicates the amount would be insignificant. Tracts with subsurface mines would not be affected; for tracts with surface mines, flood plains would not be within the assumed extraction area.

It should be noted that, in most instances, the areas protected for these 15 flood plains encompass the area of potential alluvial valley floors. However, this surface protection may not protect other hydrologic functions of the alluvial valley floors, such as moderating flows or sustaining alluvial aquifers.

Unavoidable Adverse Effects

Leaching of spoils material following mining would increase dissolved solids concentrations to between two and three times premining levels in Fish and Trout creeks in Colorado because of development of Middle Creek and Little Middle Creek tracts (all leasing alternatives) and Fish Creek Tract (High and Maximum alternatives), added to contributions from projected baseline development in these watersheds. To a lesser degree, salinity may also increase locally in drainages around other coal

lease tracts under all alternatives. These coal tract drainages, except for those in the North Platte watershed, could contribute to salinity problems downstream, although water in reclaimed mined areas would generally be suitable for livestock and wildlife.

The increased salinity in the Colorado River Basin is a controversial impact. Average dissolved solids concentration in the Green River would increase from the present 667 mg/1 to 1,016 mg/1 in the year 2000, mostly because of the No Action alternative. At this concentration, water is unsuitable for certain crops and most forms of aquatic wildlife. The effects of the Maximum alternative would increase the salinity level at Imperial Dam on the Colorado River 0.06 mg/1 above the No Action alternative level.

Mining the Atlantic Rim Tract could diminish the spring on flows to Separation Creek, making it difficult to reclaim local riparian and aspen wildlife habitat. On the Byrne Creek Tract, sediment loads and erosion rates currently are high. Any surface disturbance of this tract could result in significant increases in these parameters.

The extent to which local groundwater flow would be modified under any alternative is not known in the absence of specific mine plans and adequate data defining local groundwater occurrence. The effects should be minor during the period of active mining in each tract and should become locally significant only after completion of mining and reclamation. These impacts would then continue over the long term. There would also be a decrease in local groundwater quality around all tracts as a result of mining.

Under the High and Maximum alternatives, the proposed underground burning method for the Indian Springs Tract would produce organic combustion by-products that could migrate into groundwater and affect water quality. It could alter hydrologic characteristics of substrata. Under the Maximum alternative, pressurized flammable gas dissolved in groundwater on the Northeast Cow Creek Tract could constitute a significant hazard.

Unknown impacts could occur off-tract to the Fish Creek alluvial valley floor from mining on the Fish Creek Tract (High and Maximum alternatives). The total amount of coal resource precluded under any alternative by protection of flood plains and alluvial valley floors is unknown. However, under the Maximum alternative, protection of the flood plains on the Horse Gulch Tract would preclude production of 1.5 million tons and, on the Williams Fork Tract, 1.06 million tons.

TABLE 4-14

SUMMARY OF FLOOD PLAINS AND ALLUVIAL VALLEY FLOORS

	Unsuitable Alluvial Valley Floors	Potential (Undetermined) Alluvial Valley Floors	Unsuitable Flood plains	Suitable Flood plains
Deadman	0	0	0	0
Leucite Hills	0	0	0	1
Point of Rocks	0	0	0	1
Tract 98	0	0	0	0
Prairie Dog	0	0	0	0
Little Middle Creek	0	0	0	1
Middle Creek	0	1	2	0
Low Alternative Subtotal	0	1	2	3
Atlantic Rim	0	2	3	3
Byrne Creek	0	1	0	0
Corral Canyon	0	0	0	2
Wild Horse Draw	0	0	0	3
Rattle Snake Mesa	0	0	0	1
Signal Butte	0	0	0	3
Moderate Alternative Subtotal	0	4	5	15
Indian Springs	0	0	0	0
Pio	0	0	0	1
Winton	0	0	0	0
Peck Gulch	0	1	2	1
Hies Mountain	0	0	0	2
Fish Creek	1	0	1	1
High Alternative Subtotal	0	5	8	20
Northeast Cow Creek	0	2	0	3
Bell Rock	0	1	0	1
Williams Fork Mountain	0	1	2	4
Lay Creek	0	2	2	0
Horse Gulch	0	3	3	1
Maximum Alternative Subtotal	1	14	15	29

ENVIRONMENTAL CONSEQUENCES

Short-Term Use vs. Long-Term Productivity

The short-term use of the environment for leasing and development of new Federal coal would create a number of long-term impacts on the productivity of local and regional water resources.

The long-term consumptive use of water, coupled with the increased salt load from sewage effluent and spoil pile leaching, would significantly increase the dissolved solids concentration in the Green River. This increased salinity, coupled with the insignificant increase in the Yampa and White rivers, would significantly increase salinity in the Colorado River at Imperial Dam. Leaching of spoils aquifers would increase the salinity of perennial streams adjacent to the tracts over the long term, but, in most cases, the water would still be suitable for most current uses. There is the potential for long-term local increases in surface water salinity, local decreases in groundwater quality, and local modification of aquifers around all tracts. Dissolved solids concentrations would increase to two to three times premining levels in Fish and Trout creeks over the long term.

Irreversible or Irretrievable Commitments of Resources

Increased consumptive use of water and increased salt load from leaching of replaced spoil aquifers and sewage effluent would irretrievably increase the dissolved solids concentration in the Colorado River at Imperial Dam by about 0.06 mg/l above the No Action alternative. Increased salt loading of Fish and Trout creeks would be irretrievable.

Potential Mitigation

Impacts to existing water uses, especially to irrigated agriculture stemming from the increase in consumptive use of water, could be minimized or eliminated by completion of upstream water storage projects that could supplement low flows during the late summer and fall months when supplies are often currently inadequate. This would be more than adequate to compensate for the increased consumptive use of water in the Yampa watershed as a result of development of new Federal coal.

Augmentation of low flow in the Yampa River by supplemental water-storage projects would also reduce the impacts of pollutants in sewage effluent

on aquatic biology during periods of extreme low flow.

Construction of supplemental water-storage projects, however, would introduce additional impacts on land use, vegetation, fisheries, and wildlife. Careful analysis is necessary to determine whether the benefits of such water storage projects would outweigh their impact on the environment.

To supplement monitoring requirements in 30 CFR 816.52, monitoring should include seeps or springs newly formed from backfill material by subsurface drainage. Location, discharge rate, and water quality should be reported, as well as relationships to existing discharge points with an NPDES permit.

To supplement effluent limitations requirements in 30 CFR 816.42, effluent limitations should also include total dissolved solid levels for mines in river basins where salinity is a problem, as determined by the regulatory authorities.

Sediment control structures should be designed to handle storms expected during the life of the mine.

VEGETATION

Disturbance of vegetation would result in an insignificant regional impact, since reclamation regulations require conditions equal to or better than premining conditions to return.

Disturbance of the vegetation types described in the previous chapter would occur in varying degrees from the No Action alternative to the alternatives associated with the proposed Federal coal action. These disturbances would be both mining and nonmining related. The mining operations would result in the largest impact to the native vegetation as the disturbances would generally be of greater magnitude. Cumulative impacts of nonmining activities, such as oil and gas development, in the No Action alternative could be important as well. Drill pads, roads, powerlines, railroads, etc. could cause impacts to vegetation types similar to impacts of coal mining (discussed below), but to a lesser degree.

Operations and activities that would result in vegetation destruction or disturbance due to coal mining are coal removal, topsoil stockpiles, haul roads, mine facilities, access roads, railroads, powerlines, and associated population growth.

Removal of vegetation by mining would have secondary effects on the surrounding vegetation.

ENVIRONMENTAL CONSEQUENCES

Once vegetation is removed and unavailable to herbivores, vegetation on adjacent areas is subjected to increased utilization. Haul road dust and fugitive coal dust from mining operations may be deposited on the surrounding vegetation. Dust-covered vegetation is less palatable to livestock and wildlife and less productive during the life of the mine.

Population increases associated with expansion from development would cause destruction of native vegetation surrounding various population centers as housing, schools, shopping areas, etc., were built. Increased numbers of people in the area would result in additional disturbance by recreational activities such as off-road vehicle use.

Length and magnitude of impacts, in terms of the return of productivity, would depend upon the success of reclamation. The previous section on soils discusses this in some detail.

Vegetation destruction could result in the invasion of noxious and undesirable species onto open, unreclaimed disturbed areas. The weeds would compete with reclamation efforts and could inhibit the establishment of desired vegetation.

Vegetation removal and subsequent reclamation would result in the loss of natural diversity. The presence of diverse vegetation and natural systems is an important ecological factor. Highly integrated and complex ecosystems possess considerable stability and are therefore capable of responding to severe, short-term environmental impacts. The stability of a native community is directly related to its species diversity.

Vegetation removal also results in the present vegetative successional stage being lost. However, secondary succession would occur on reclaimed land. The aging phenomenon, or succession, in an ecosystem is best described as an evolution toward high diversity. The climax community results when no other combination of species is successful in outcompeting or replacing the climax community.

The soil and microclimate produced after mining would be different from premining conditions. Consequently, the reestablished plant communities would differ from the plant communities that existed prior to mining. These differences include characteristics such as floristic composition, presence and distribution of life forms, and diversity and spatial arrangement of species.

The more diversified the biota, the less chance that a shift in one component would adversely affect the system as a whole. Therefore, diverse vegetation is better capable of withstanding extreme climatic conditions, infestations, grazing pressures, and change.

The above narrative discusses the impacts to vegetation of all the alternatives. It is only the mag-

nitude of these impacts that varies with each alternative.

The vegetation of the region would continue to be affected even without the proposed Federal action. The No Action alternative would result in the loss of native vegetation in Colorado and Wyoming. Coal development on state, private, and existing Federal leases would continue to take place, as well as oil and gas activity and other noncoal related projects. Table 4-15 displays the estimated maximum extent of these disturbances by acres lost in each vegetation type.

Under a worst-case analysis, the Federal action of leasing all 24 new tracts would result in an increased disturbance of native vegetation over and above that represented by the baseline. The Maximum Leasing alternative would result in a total loss of 36,961 acres of the vegetation over baseline disturbance totals by the end of the life of the mines. Table 4-16 displays the vegetation disturbance by vegetation type for the Maximum alternative.

Under all alternatives, the significance of the loss of the native vegetation is not high in relationship to the total regional area, but may be noteworthy on a site-specific basis. The loss of areas of sagebrush, mountain shrub, saltbush, greasewood, and pinyon/juniper is important to wildlife as these types are considered winter range for big game. The loss of any riparian habitat acreage would be important to wildlife, since this type is scarce to begin with and provides for a high diversity of wildlife species (see Animal Life). The loss of grazing land acreage would be important to livestock production (see Land Use). On the Atlantic Rim Tract, introduced under the Moderate alternative, locally scarce vegetation communities would be eliminated on steep, shallow slopes, and riparian and aspen communities along Separation Creek would be difficult to reclaim.

Threatened, Endangered, and Rare/ Sensitive Plant Species

Section 7 consultation with the U.S. Fish and Wildlife Service has been initiated by both the Craig and Rawlins BLM District offices. At the time of this writing, BLM has not received a response in the form of a biological opinion from the Fish and Wildlife Service on this issue. Based on the analysis of the data available to BLM, it is not anticipated that there would be significant impacts to the federally listed plant species due to proposed coal leasing.

The Rock Springs BLM District determined that no federally listed species would be affected by the proposed Federal action. They therefore deter-

TABLE 4-15

PROJECTED VEGETATION DISTURBANCES UNDER NO ACTION

Vegetation Type	Acres of Disturbance								Total Disturbance			
	Colorado				Wyoming							
	1983	1992	1995	2000	1983	1992	1995	2000	1983	1992	1995	2000
Grasslands	383	575	612	673	7,127	8,479	8,722	9,737	7,510	9,054	9,334	10,410
Sagebrush	8,070	12,083	12,858	14,148	92,913	110,352	113,423	126,607	100,983	122,435	126,281	140,755
Mountain Shrub	3,620	5,464	5,817	6,399	2,851	3,392	3,490	3,896	6,471	8,856	9,307	10,295
Pinyon/Juniper	2,281	3,451	3,674	4,041	5,701	6,783	6,978	7,790	7,982	10,234	10,652	11,831
Saltbush	576	863	918	1,010	9,977	11,870	12,211	13,632	10,553	12,733	13,129	14,642
Greasewood	191	288	306	337	13,391	15,870	16,292	18,184	13,582	16,158	16,598	18,521
Aspen	1,339	2,013	2,143	2,358	2,851	3,392	3,490	3,895	4,190	5,405	5,633	6,253
Riparian	377	575	612	673	1,425	1,696	1,744	1,947	1,802	2,271	2,356	2,620
Cropland	1,146	1,723	1,837	2,020	2,851	3,391	3,489	3,895	3,997	5,114	5,326	5,915
Rock Outcrop/Ridges	--	--	--	--	1,425	1,696	1,744	1,947	1,425	1,696	1,744	1,947
Conifers	1,148	1,725	1,838	2,021	2,025	2,655	2,865	3,215	3,173	4,380	4,703	5,236
TOTALS	19,131	28,760	30,615	33,680	142,537	169,576	174,448	194,745	161,668	198,336	205,063	228,425

NOTE: Figures do not include oil shale developments, all of which are outside the vegetation analysis area.

TABLE 4-16
MAXIMUM ALTERNATIVE PLUS BASELINE

Vegetation Type	Acres of Disturbance								Total Disturbance			
	Colorado				Wyoming							
	1983	1992	1995	2000	1983	1992	1995	2000	1983	1992	1995	2000
Grasslands	383	956 (381)	1,267 (655)	1,778 (1,105)	7,127	8,692 (213)	9091 (369)	10,292 (555)	7,510	9,648 (594)	10,358 (1,024)	12,070 (1,660)
Sagebrush	8,070	13,251 (1,168)	15,033 (2,175)	17,485 (3,337)	92,913	113,004 (2,652)	118,720 (5,297)	134,463 (7,856)	100,983	126,255 (3,820)	133,753 (7,472)	151,948 (11,193)
Mountain Shrub	3,620	5,973 (509)	6,301 (484)	7,201 (802)	2,851	3,908 (516)	4,285 (795)	5,064 (1,168)	6,471	9,881 (1,025)	10,586 (1,279)	12,265 (1,970)
Pinyon/Juniper	2,281	3,462 (11)	3,689 (15)	4,063 (22)	5,701	6,783 (0)	6,984 (6)	7,803 (13)	7,982	10,245 (11)	10,673 (21)	11,866 (35)
Saltbush	576	1,039 (176)	1,123 (205)	1,215 (205)	9,977	12,179 (309)	12,855 (644)	14,777 (1,145)	10,553	13,218 (485)	13,978 (849)	15,992 (1,350)
Greasewood	191	288 (0)	306 (0)	337 (0)	13,391	15,968 (98)	16,470 (178)	18,466 (282)	13,582	16,256 (98)	16,776 (178)	18,803 (282)
Aspen	1,339	2,492 (479)	2,275 (132)	2,564 (206)	2,851	3,434 (42)	3,569 (79)	4,022 (127)	4,190	5,926 (521)	5,844 (211)	6,586 (333)
Riparian	377	575 (0)	612 (0)	673 (0)	1,425	1,713 (17)	1,773 (29)	1,989 (42)	1,802	2,288 (17)	2,385 (29)	2,662 (42)
Cropland	1,146	1,876 (153)	2,179 (342)	2,501 (481)	2,851	3,398 (7)	3,532 (43)	3,993 (98)	3,997	5,274 (160)	5,711 (385)	6,494 (579)
Rock Outcrop/Ridges	--	--	--	--	1,425	1,715 (19)	1,765 (21)	1,970 (23)	1,425	1,725 (29)	1,765 (21)	1,970 (23)
Conifers	1,148	1,725 (0)	1,838 (0)	2,021 (0)	2,025	2,655 (0)	2,865 (0)	3,215 (0)	3,173	4,380 (0)	4,703 (0)	5,236 (0)
TOTALS	19,131	31,637 (2,887)	34,623 (4,008)	39,838 (6,158)	142,537	173,449 (3,873)	181,909 (7,461)	206,054 (11,309)	161,668	205,096 (6,760)	216,532 (11,469)	245,892 (17,467)

NOTE: Acres in parentheses are acres of disturbance for the Maximum alternative alone, excluding the baseline.

ENVIRONMENTAL CONSEQUENCES

mined that Section 7 consultation with the U.S. Fish and Wildlife Service was not necessary.

Unavoidable Adverse Effects

On the Atlantic Rim Tract in Wyoming (Moderate through Maximum alternatives), there would be an unavoidable adverse impact to the locally scarce vegetation types on steep slopes (greater than 40 percent).

Short-Term Use vs. Long-Term Productivity

The short-term use of coal development on the Atlantic Rim Tract would result in the long-term loss of locally scarce vegetation types on slopes greater than 40 percent.

Irreversible or Irretrievable Commitments of Resources

The vegetation loss on steep slopes on the Atlantic Rim Tract would be both irreversible and irretrievable.

ANIMAL LIFE

Introduction

Industrial and urban development and human population growth are projected to continue within the EIS region independent of additional Federal coal leasing. This growth would further reduce the quantity and quality of habitat currently available to support key animal species--those of high value or interest.

Mining actions that would adversely affect wildlife are railroad and road building, mine facility construction, mining operations, and transportation of resources by truck or rail. Other mineral related development, oil and gas exploration, agriculture, urban expansion, and recreational development would convert wildlife habitat to other uses and place stress on animal populations.

Impacts to wildlife would occur as a result of these activities through loss of living space, reduc-

tion in food supply, increased stress, and direct death.

The analysis of impacts for deer, elk, pronghorn antelope, sage grouse, and sharp-tailed grouse habitat in Colorado does not reflect application of the committed mitigation listed for these species in Appendix 6. The effectiveness of this mitigation measure is unknown, since it has never been tested and there is insufficient information available to estimate effectiveness. Therefore, to ensure that all potential problem areas are identified, the analysis of these species and their habitats reflects worst-case impacts without application of the measure.

Impacts to Animal Habitat

Any action that removes or degrades water sources or native vegetation, or which alters natural topography, modifies an area's ability to support animal populations. In most cases, the changes due to industrial and urban development reduce carrying capacity for wildlife. Some animal species are eliminated from the developed area, while others continue to exist at lower levels.

Complete loss of habitat would occur on mined areas, railroads, roads, and housing areas. Vegetation removal would make these areas incapable of supporting most animals. Some habitat losses would be short term, e.g., mined areas and facility sites which would be reclaimed. Where roads, railroads, housing developments, and shopping centers were not reclaimed, losses would be long term.

In addition to habitats which are destroyed, some areas would become unusable to animals that are intolerant of human activity. Great variation in tolerance levels exists between species and among individuals of a species. Particularly sensitive are birds of prey during nesting season and big game animals under winter stress.

Quantification and analysis of this aspect of habitat loss is difficult due to species variations and the lack of data regarding the size of the area which is unusable. Distances from human activity ranging from 1/4 mile to more than 1 mile have been reported as unusable by raptors and big game (Call 1979; Steenhof 1978; Snow 1974; University of Idaho 1976). Immediately adjacent to intense human activity, use by these species would be reduced nearly 100 percent. Farther away, use would increase until predisturbance levels were reached approximately 1 mile distant (Bureau of Land Management 1979b, 1980). For this analysis, estimates of unusable habitat are based on the assumption that use by sensitive wildlife would be reduced 100

ENVIRONMENTAL CONSEQUENCES

percent within a 1/4 mile radius of high use human activities such as mine facilities, active mining, and urban developments.

Aquatic Habitat

Two general types of aquatic habitat would be adversely impacted by development and human population growth. Small stock ponds, springs, and seeps which do not support fish would be affected by complete removal. These water sources control the distribution and occurrence of aquatic and terrestrial animals, as well as vegetation. Amphibians, aquatic insects, and some vegetation types would be locally eliminated by water source destruction. Dependent terrestrial animals would be displaced to areas where water was present.

Fisheries habitat such as streams, rivers, lakes, and reservoirs would be adversely affected by reductions in water quantity and degradation of quality. Both cold and warm water fish reproductive success and survival are dependent upon narrow tolerances to changes in water level, flow, temperature, silt load, and food availability.

Under the No Action alternative through the year 2000, development in the region would significantly reduce flows and degrade water quality in fisheries habitat. Beginning with the Low Leasing alternative, these adverse impacts would increase in Colorado's Fish and Trout creeks due to water quality degradation associated with mining Middle Creek, Little Middle Creek, and Fish Creek tracts. This increase would represent only a small portion of the total significant cumulative impacts (leasing alternatives plus No Action alternative), but it would be locally important. The Water Resources section describes these changes in water quality and quantity more fully.

Terrestrial Habitat

Terrestrial habitat would be removed from wildlife production by coal and noncoal related activities that either removed vegetation by surface disturbance or made lands uninhabitable due to human activity. Continued development and human population growth would significantly reduce food supplies and cover on three specific habitat types--riparian, aspen, and sagebrush--and one animal use type--big game winter range. Big game winter range is composed of six habitat types, including sagebrush and riparian. The four additional types are mountain shrub, pinyon/juniper, saltbush, and greasewood. Estimated significant habitat losses are shown in table 4-17.

The remaining four types--grasslands, cropland, rock outcrop/ridges, and conifers--would not be significantly impacted under any alternative due to the small acreage disturbed or their low value to wildlife.

Riparian Habitat

Comprising only one percent (204,306 acres) of the total habitat analysis area, this type is of high value and importance due to its scarcity and high diversity of plant and animal species.

The loss of 588 acres in Colorado and 2,223 acres in Wyoming totaling 2,811 acres under the No Action alternative in 1983 is significant. This loss would increase to 4,087 acres by the year 2000. Although this represents only 2 percent of the total riparian habitat occurring in the habitat analysis area, any loss of this scarce type is significant. Leasing Atlantic Rim, Corral Canyon, Byrne Creek, and Wild Horse Draw under the Moderate alternative would remove an additional 111 acres from wildlife production by the end of mine life. This would be additive to the significant impact resulting from No Action.

Due to the occurrence of a great variety of plants, ranging from grasses to large trees, this type is difficult to replace when disturbed. Often, no similar habitat is available to support the wildlife displaced by this loss. Reclamation may take 50 or more years to re-establish the former structural diversity, species composition, and production. Urban and recreational development would permanently remove some of this type from wildlife production.

Aspen

This scarce type comprises only 1.7 percent of the total Wyoming portion of the habitat analysis area. Due to its high structural diversity, the aspen type supports many wildlife species. Re-establishing mature aspen trees and the diverse understory of grasses, forbs, and shrubs would be difficult and require 50 or more years.

Loss of aspen in Colorado would not be significant under any alternative in any year. The number of acres impacted would be a small portion of the total available. In Wyoming 4,448 acres would be unavailable for wildlife production in 1983 under the No Action alternative. This would also be insignificant.

Loss of the aspen type in Wyoming would increase with the addition of the Atlantic Rim Tract in the Moderate alternative. This tract contains aspen habitat of importance to the elk herd in the Baggs

TABLE 4-17

ESTIMATED ANIMAL HABITAT LOSSES

Alternative	Total Acres of Habitat *			
	Loss due to Surface Disturbance and Human Activity			
	Riparian	Aspen	Sagebrush	Big Game Winter Habitat **
<u>No Action</u>				
1983	2,811	6,537	157,533	220,542
1992	3,543	8,432	190,999	269,391
1995	3,676	8,787	196,999	278,184
2000	4,087	9,755	219,578	309,916
<u>Low Alternative</u>				
1983	0	0	0	0
1992	0	0	209	841
1995	0	0	799	1,847
2000	0	0	1,755	3,356
EML	0	0	6,318	10,638
<u>Moderate Alternative</u>				
1983	0	0	0	0
1992	27	81	3,151	4,625
1995	45	144	6,201	8,680
2000	67	218	10,291	14,073
EML	111	530	21,823	30,955
<u>High Alternative</u>				
1983	0	0	0	0
1992	27	145	4,426	6,369
1995	45	222	8,117	11,195
2000	67	296	13,358	18,115
EML	111	608	27,706	38,229
<u>Maximum Alternative</u>				
1983	0	0	0	0
1992	27	254	5,959	8,511
1995	45	329	11,656	15,332
2000	67	520	17,461	23,200
EML	111	1,359	37,774	50,897

* Includes acres unusable due to human activity within 1/4 mile radius of disturbed areas. This inflates the actual acres disturbed by a factor of .56.

** Big game winter habitat total includes riparian and sagebrush habitat acreages.

ENVIRONMENTAL CONSEQUENCES

data analysis unit. An ongoing elk habitat use study must be completed before the significance of the loss of this habitat can be determined (Site Specific Analysis 1983). This is discussed further in the Animal Population section.

Sagebrush

Covering 57 percent of the total habitat analysis area, the sagebrush type is essential to the survival of sage grouse and big game. Populations of sage grouse, elk, mule deer, and pronghorn antelope are dependent upon it for food, particularly in winter. It is often the only food source available when snow depth forces these animals onto lower elevation winter habitat. The sagebrush type makes up 69 percent of all available winter use areas.

Loss of 157,533 acres under the No Action alternative by the year 1983 would be significant to deer and elk in Colorado and to deer in the Southwest Wyoming ES area because of a lack of availability of adjacent habitat. Sagebrush habitat loss would increase to 219,578 acres in the year 2000. Although some loss of sagebrush would occur in the Southcentral Wyoming ES area, big game populations would not be reduced because of the availability of adjacent habitat.

All leasing alternatives would remove additional sagebrush habitat in all analysis years. This loss would be additive to the acres removed under No Action and could be particularly important in Wyoming with the leasing of Atlantic Rim and Corral Canyon tracts under the Moderate, High, and Maximum alternatives.

Big Game Winter Habitat

Essential to the maintenance and survival of big game populations, winter habitat controls the occurrence and density of elk, deer, and pronghorn antelope within the habitat analysis area. Loss of the food and cover associated with these areas can result in big game population declines.

As of 1983, 220,542 acres of big game winter habitat have been removed from wildlife production. This would increase to a total of 309,916 acres in the year 2000 under No Action. This would be significant. In Colorado, much of the winter range is at or near carrying capacity and cannot support additional deer and elk that would be displaced from disturbed winter range. All leasing alternatives would add to the significant No Action losses. Particularly significant would be the loss of winter ranges resulting from leasing Iles Mountain and Peck Gulch (High and Maximum) and Williams Fork Mountain (Maximum) tracts.

Overall, losses under No Action would not be significant in Wyoming. However, there is concern for pronghorn habitat in the Baggs Herd Unit due to baseline coal development. For elk in the Baggs data analysis unit, loss of crucial winter range may be significant with leasing of the Atlantic Rim Tract under the Moderate alternative. The Maximum alternative, which would include the Northeast Cow Creek Tract, would further impact this elk herd by removing habitat and subjecting the herd to human disturbance. The full significance cannot be assessed until the ongoing elk study is completed. Finally, leasing the Pio Tract (High and Maximum) would remove a locally important deer winter range.

Threatened and Endangered Species Habitat

Although no critical habitat for federally listed species occurs, habitat used by these animals is present. Essential habitat for the state listed greater sandhill crane also exists. Under the No Action alternative, some of these areas could be disturbed or degraded by actions not controlled by the Federal government. No significant adverse impacts would occur in any analysis year for any alternative where the Federal government exercises control.

Wild Horse Habitat

Some wild horse habitat would be removed or degraded by projected baseline development and additional Federal coal leasing. Losses would represent only a small portion of available range and therefore would not be significant under any alternative in any analysis year.

Impacts to Animal Populations

Animal population declines result from many complex factors. The most significant is habitat loss and degradation. Direct animal mortality due to collision with vehicles, entrapment in fences, illegal and indiscriminate shooting, dog attacks, harassment by people, and environmental pollutants can be equally important.

Where animal population data are available, the number of animals lost due to habitat removal and degradation can be estimated. These estimates are based on animal densities, or the average number of animals that occur throughout a habitat area. Animal densities vary greatly by species and season and from year to year. The loss estimates presented in table 4-18 are based on currently available animal density data (Colorado Division of Wildlife 1980, 1983; Southwestern Wyoming Coal

TABLE 4-18
ESTIMATED ANIMAL LOSSES DUE TO HABITAT LOSS

Alternative	Number of Animals	
	Elk *	Mule Deer °
<u>No Action</u>		
1983	534	2,834
1992	803	3,920
1995	856	4,127
2000	941	4,561
<u>Low Alternative</u>		
1983	0	0
1992	24	59
1995	29	43
2000	50	61
EML	153	150
<u>Moderate Alternative</u>		
1983	0	0
1992	84	148
1995	135	198
2000	217	305
EML	456	521
<u>High Alternative</u>		
1983	0	0
1992	113	200
1995	170	268
2000	284	424
EML	575	720
<u>Maximum Alternative</u>		
1983	0	0
1992	227	484
1995	425	733
2000	669	1,127
EML	1,410	2,182

* Colorado losses only.

° Colorado and southwestern Wyoming losses.

ENVIRONMENTAL CONSEQUENCES

ES 1978). In other portions of the habitat analysis area where animal density data are not available, general population size and distribution data are sufficient to analyze the significance of impacts to animal populations, even though precise loss numbers cannot be calculated.

The animal loss numbers shown are not absolute. They should be regarded as magnitude indicators and looked at in relation to both the habitat losses presented in table 4-17 and the total number of animals occurring in the habitat analysis area as shown in Chapter 3.

Animal losses resulting from causes other than habitat loss are difficult to quantify. It is not possible to calculate losses in animal numbers from existing data. However, they can be partially assessed very roughly by indirect means. Increases in vehicle traffic and human population, as projected under Transportation and Economics, would increase animal losses (tables 4-19 and 4-20). These losses are presented as an expected percent increase over 1980 levels. These, as well as the table 4-18 losses, will be discussed further as applicable under the section for each animal species.

Aquatic Wildlife

Terrestrial animals that are dependent upon water sources removed by disturbance would be displaced. In addition, fish and amphibians would be lost. This should not result in significant adverse impacts to terrestrial animal or amphibian populations under any alternative on a regional basis because very few of these water sources would be removed when compared to the overall availability of water sources. In arid areas of Wyoming this becomes locally important under the No Action alternative in 1983, remaining so throughout all other alternatives.

Fisheries, particularly cold water populations, would be adversely impacted by agricultural, industrial, and urban development and by human population growth. Reduced stream flows and lowered water quality would, at best, increase costs of maintaining game fish populations. In some cases, local self-sustaining sport fisheries could be eliminated.

Human population increases of 64 percent in Colorado and 25 percent in Wyoming under the No Action alternative in the year 2000 could cause locally significant fisheries declines. Regional populations would not decline significantly.

The magnitude of these adverse impacts would not increase greatly with coal leasing under any leasing alternative. However, impacts would be locally important to fisheries in Colorado's Fish and Trout creeks.

Terrestrial Wildlife

Animal population declines would result from habitat losses and accidental and intentional killing. Species which are widespread and have high reproductive capacity--amphibians, reptiles, nongame birds except birds of prey, game birds except sage and sharp-tailed grouse, and small mammals--would be locally reduced or eliminated in the short term. Regionally, declines would not be significant under any alternative. These populations would rapidly re-establish with reclamation of disturbed lands.

Some birds with restricted environmental requirements and large mammals with lower reproductive rates would be significantly impacted. They are discussed below.

Birds of Prey

Loss of nest sites through disturbance and human activity near active nests would reduce carrying capacity and result in reproductive failure. The number and location of nests destroyed by the No Action alternative's surface disturbance is not predictable due to a lack of information on numbers or locations of nests in the region. Due to human population increases (64 percent in Colorado and 25 percent in Wyoming by 2000), the probability of disturbance near nest sites would increase. These nests are protected by law, but enforcement is difficult. Populations would not significantly decline as a result of actions controlled by BLM under the No Action alternative in any analysis year.

Raptor nests are protected by buffer zones (committed mitigation) where they occur on the proposed coal lease tracts. This mitigation minimizes most adverse impacts to nest sites and raptor populations resulting from the leasing alternatives. Certain nests are not adequately protected since BLM does not control the surrounding private lands or existing county roads where increased traffic would adversely impact nesting raptors. In Colorado, leasing of the Lay Creek Tract under the Maximum alternative would impact five golden eagle nests that occur near county road 17. Increased vehicle traffic could cause abandonment of nests which are within 1/8 mile of this road.

In Wyoming, leasing the Leucite Hills Tract under all four leasing alternatives and the Atlantic Rim Tract under the Moderate, High, and Maximum alternatives would impact golden eagle, prairie falcon, Cooper's hawk, and goshawk nests that cannot be adequately protected because they are on or very near private land.

TABLE 4-19

ESTIMATED ANIMAL LOSSES DUE TO OTHER HUMAN CAUSES IN COLORADO

Alternative	Percent Increase in Losses Due to Vehicle Collisions*		Percent Increase in Losses Due to All Other Human Causes *			
	Elk	Mule Deer	Elk	Mule Deer	Pronghorn Antelope	Birds of Prey
<u>No Action</u>						
1992	+32	+32	+51	+51	+51	+51
1995	+40	+40	+64	+64	+64	+64
2000	+51	+51	+64	+64	+64	+64
<u>Low Alternative</u>						
1992	+2	+2	+1	+1	+1	+1
1995	+4	+4	+2	+2	+2	+2
2000	+4	+4	+2	+2	+2	+2
<u>Moderate Alternative</u>						
1992	+6	+6	+2	+2	+2	+2
1995	+14	+14	+5	+5	+5	+5
2000	+14	+14	+5	+5	+5	+5
<u>High Alternative</u>						
1992	+11	+11	+5	+5	+5	+5
1995	+24	+24	+10	+10	+10	+10
2000	+26	+26	+12	+12	+12	+12
<u>Maximum Alternative</u>						
1992	+19	+19	+8	+8	+8	+8
1995	+37	+37	+16	+16	+16	+16
2000	+38	+38	+18	+18	+18	+18

* Vehicle traffic and human population increase estimates are not available beyond the year 2000.

TABLE 4-20

ESTIMATED ANIMAL LOSSES DUE TO OTHER HUMAN CAUSES IN WYOMING

Alternative	Percent Increase in Losses Due to Vehicle Collisions*		Percent Increase in Losses Due to All Other Human Causes *			
	Elk	Mule Deer	Elk	Mule Deer	Pronghorn Antelope	Birds of Prey
<u>No Action</u>						
1992	+38	+38	+20	+20	+20	+20
1995	+50	+50	+23	+23	+23	+23
2000	+69	+69	+25	+25	+25	+25
<u>Low Alternative</u>						
1992	+1	+1	0	0	0	0
1995	+1	+1	+1	+1	+1	+1
2000	+1	+1	+1	+1	+1	+1
<u>Moderate Alternative</u>						
1992	+2	+2	+1	+1	+1	+1
1995	+10	+10	+6	+6	+6	+6
2000	+10	+10	+6	+6	+6	+6
<u>High Alternative</u>						
1992	+5	+5	+2	+2	+2	+2
1995	+15	+15	+8	+8	+8	+8
2000	+19	+19	+10	+10	+10	+10
<u>Maximum Alternative</u>						
1992	+6	+6	+3	+3	+3	+3
1995	+20	+20	+12	+12	+12	+12
2000	+25	+25	+14	+14	+14	+14

* Vehicle traffic and human population increase estimates are not available beyond the year 2000.

ENVIRONMENTAL CONSEQUENCES

Sage Grouse

Destruction of winter concentration areas, brood-rearing areas, and strutting/nesting complexes would be detrimental to local grouse populations. Significant regional population declines are not expected for any analysis year under the No Action alternative.

In Wyoming, leasing the Atlantic Rim and Corral Canyon tracts under the Moderate alternative would remove sage grouse nesting and brood-rearing habitat. This would be significant to local populations but would not greatly decrease regionwide grouse numbers.

Elk

Loss of winter ranges, disruption of migration routes, destruction of calving areas, and human-caused mortality would result in population declines. Significant declines in elk numbers would make fewer animals available for hunting and viewing.

In Colorado the estimated minimum elk loss due to loss of habitat under the No Action alternative in 1983 was 534 animals. This is significant because it would reduce populations below Colorado Division of Wildlife herd objectives. By the year 2000, 941 animals, or 3.6 percent of the total 1982 winter population within data analysis units E-2, E-5, E-6, and E-21, would be lost. In addition to this, an increase in human population of 64 percent and a vehicle traffic increase of 51 percent in the year 2000 would cause further losses of elk (table 4-19).

Losses in Wyoming under the No Action alternative by the year 2000 would not be significant.

Additional elk losses would result from leasing under the Moderate, High, and Maximum alternatives in Colorado and Wyoming. Leasing the Atlantic Rim and Northeast Cow Creek tracts would impact elk in the Baggs data analysis unit by removing crucial winter ranges and increasing stress due to human disturbance. The significance of this impact is unknown pending completion of the ongoing elk habitat study.

In Colorado, elk declines would occur in data analysis units E-5 and E-6 with leasing of the Iles Mountain and Peck Gulch tracts (High and Maximum) and the Williams Fork Mountain Tract (Maximum). Reasons would be similar to those presented above for Wyoming.

Mule Deer

Populations would be reduced by factors similar to those affecting elk numbers--winter range losses

and direct mortality due to increased human population and vehicle traffic.

As a result of loss of habitat, Colorado mule deer losses would amount to 1,744 and 3,076 animals by the years 1983 and 2000, respectively, under the No Action alternative, which would be significant. The loss in the year 2000 would represent 2.8 percent of the total 1982 winter population in data analysis units D-2, D-6, and D-7. Additional human caused mortality would add to this (table 4-19).

In 1983, an estimated loss of 1,090 deer occurred in southwest Wyoming, which is significant. By the year 2000 this loss would increase to 1,485 deer under No Action. Human caused mortality would be in addition to this.

Deer losses would increase under all leasing alternatives, adding to the significant loss occurring in the No Action alternative. In Colorado a significant number of acres of important winter habitat would be removed by leasing the Signal Butte, Iles Mountain, Lay Creek, and Horse Gulch tracts. Increased human population and vehicle traffic would further increase these losses.

In Wyoming, leasing under the Low alternative could cause significant animal losses. Removal of important winter range would occur with development of the Pio Tract (High and Maximum alternatives).

Pronghorn Antelope

Antelope losses would result from winter range losses, human barriers to natural seasonal movements, and expansion of transportation systems, both road and rail.

Pronghorn losses in Colorado would not be significant under any alternative in any analysis year. Losses would represent less than one percent of total antelope numbers.

Overall Wyoming pronghorn losses under the No Action alternative would not constitute a significant impact. However, there is concern for pronghorn in the Baggs herd unit due to baseline coal development. By 1992 under the Low alternative, cumulative losses due to transportation system expansion, both rail and road, associated with development of the Leucite Hills and Point of Rocks tracts would be significant. These losses would increase under the High alternative with development of the Pio and Winton tracts.

ENVIRONMENTAL CONSEQUENCES

Moose

No significant impacts to moose populations would occur under any alternative in any year.

Threatened and Endangered Wildlife

The water resources analysis predicts reduced flows in the Green River due to increased water demand under the No Action alternative. If this occurs, the Colorado squawfish and humpback chub, both federally listed as endangered, may be adversely affected under the No Action alternative. (BLM has no control over this situation.) These species are protected by the Endangered Species Act, so any action that may affect them will be reviewed by the U.S. Fish and Wildlife Service. If their existence is jeopardized, adverse impacts must be mitigated.

Actions under any of the leasing alternatives are not expected to adversely affect or jeopardize the continued existence of any terrestrial federally or state listed threatened or endangered species. Under provisions of the Endangered Species Act of 1973, as amended, Federal actions must be reviewed by the U.S. Fish and Wildlife Service for compliance. The state of Colorado has been consulted regarding their listed species. (Wyoming has no state listed species.) BLM is currently awaiting responses.

Wild Horses

Since only a small portion of the total available horse range would be affected, no significant decline in wild horse numbers would result under any of the alternatives in any analysis year.

Unavoidable Adverse Effects

Tables 4-21 and 4-22 summarize the magnitude and significance of the previously presented unavoidable adverse impacts to animal habitats and populations.

Short-Term Use vs. Long-Term Productivity

In the short term, regional habitat losses would be 0 to 111 acres of riparian, 0 to 1,359 acres of aspen, 6,318 to 37,774 acres of sagebrush, and 10,638 to 50,897 acres of big game winter range, depending on the alternative selected.

In Colorado Data Analysis Units D-2, D-6, and D-7, deer numbers would decline by about 1 percent overall, with more severe declines occurring locally. Declines of 1 to 5 percent of overall elk numbers in Data Analysis Units E-2, E-5, E-6, and E-7 would also occur, again depending on the alternative.

Locally, deer, pronghorn, sagegrouse, and raptors would be displaced in Wyoming.

Long-term productivity should return to premining levels with successful reclamation.

Irreversible or Irretrievable Commitments of Resources

Habitats permanently converted to urban development, roads, and railroads, and those habitats made uninhabitable because of human proximity, are irreversibly and irretrievably lost. Individual animals, along with their offspring and genetic traits, killed by vehicles, poachers, or increased stress, are likewise lost.

Potential Mitigation for Colorado

Leasing and development of the Lay Creek Tract (Maximum alternative) and Signal Butte Tract (High and Maximum alternatives) would cause specific adverse impacts to wildlife that would not be alleviated by committed mitigation. Road kills could also become a problem. The following proposed mitigating measures would lessen these impacts.

Lay Creek Tract

Five golden eagle nest sites along county road 17 that are not adequately protected by stipulations on-tract and buffer zones off-tract would require additional mitigation to reduce adverse impacts. Vehicle traffic, both coal trucks and employees' vehicles, should be rerouted to avoid this road in breeding season, February 1 to July 31. Busing or carpooling might be used to transport employees, thus reducing the number of vehicles passing these nests. Other measures may be required or substituted upon approval of the U.S. Fish and Wildlife Service. They have responsibility for protection of eagle nests and would have to be consulted if this tract were leased.

TABLE 4-21

SUMMARY OF UNAVOIDABLE ADVERSE IMPACTS ON COLORADO WILDLIFE

Impacted Element	Alternative					Comments and Tracts with Specific Problems
	No Action	Low Alt.	Mod Alt.	High Alt.	Max Alt.	
<u>Animal Habitat</u>						
Riparian	S	S	S	S	S	Component of big game winter range: Signal Butte, Iles Mountain, Peck Gulch, Williams Fork, Lay Creek, and Horse Gulch.
Aspen	NS	NS	NS	NS	NS	
Sagebrush	S	S	HS	HS	HS	
Big Game Winter Range	S	S	HS	HS	HS	
Aquatic	S	S	S	S	S	
Threatened and Endangered	N	N	N	N	N	
<u>Animal Populations</u>						
Elk	S	S	S	HS	HS	Iles Mountain, Peck Gulch, and Williams Fork.
Mule Deer	S	S	HS	HS	HS	Signal Butte, Iles Mountain, Lay Creek, and Horse Gulch.
Pronghorn Antelope	NS	NS	NS	NS	NS	
Sagegrouse	NS	NS	NS	NS	NS	
Birds of Prey	NS	NS	NS	NS	S	Lay Creek.
Threatened and Endangered	N	N	N	N	N	
Wild Horses	N	N	N	N	N	
Game Fish	S	S	S	S	S	Middle Creek, Little Middle Creek, and Fish Creek tracts would impact Fish and Trout creeks.

N - None or not measurable

NS - Not significant

S - Significant

HS - Highly significant

TABLE 4-22

SUMMARY OF UNAVOIDABLE ADVERSE IMPACTS ON WYOMING WILDLIFE

Impacted Element	Alternative					Comments and Tracts with Specific Problems
	No Action	Low Alt.	Mod Alt.	High Alt.	Max Alt.	
<u>Animal Habitat</u>						
Riparian	S	S	S	S	S	Atlantic Rim. Plo--deer; Atlantic Rim and Corral Canyon--sage grouse. Northeast Cow Creek, Atlantic Rim, and Plo.
Aspen	NS	NS	P	P	P	
Sagebrush	S	S	HS	HS	HS	
Big Game Winter Range	S	S	HS	HS	HS	
Aquatic	S	S	S	S	S	
Threatened and Endangered	N	N	N	N	N	
<u>Animal Populations</u>						
Elk	NS	NS	P	P	P	Atlantic Rim and Northeast Cow Creek. Plo.
Mule Deer	S	S	S	S	S	
Pronghorn Antelope	NS	S	S	S	S	Transportation systems--Leucite Hills, Point of Rocks, Plo, and Winton
Moose	NS	NS	NS	NS	NS	
Sage grouse	NS	NS	S	S	S	Atlantic Rim and Corral Canyon. Atlantic Rim AND Leucite Hills.
Birds of Prey	NS	S	S	S	S	
Threatened and Endangered	N	N	N	N	N	
Wild Horses	N	N	N	N	N	Development alternatives would add very little to the significant impact caused by the No Action alternative.
Game Fish	S	S	S	S	S	

N - None or not measurable

NS - Not significant

S - Significant

HS - Highly significant

P - Pending study

ENVIRONMENTAL CONSEQUENCES

Signal Butte Tract

The location of the 318 acres of surface disturbance that would result from construction of the railroad and power and telephone lines is not known. One probable route parallels and crosses the Yampa River. Stipulations would be needed if construction and operations occurred in riparian or aquatic habitats or within 1/2 mile of raptor nest sites, or if impacts were occurring to threatened or endangered species or their habitats. In the case of threatened or endangered species or habitats, the U.S. Fish and Wildlife Service would have to be consulted regarding anticipated impacts and possible mitigation.

The appropriate mitigating measures would not be formulated until the location, season, duration, and magnitude of disturbance was known. Possible measures would (1) designate areas to avoid, (2) limit season of construction, or (3) recommend construction methods designed to minimize alteration of the streamside vegetation, stream channel, or water quality in the Yampa River.

Road Kills

Loss of big game, particularly deer and elk due to collisions with passenger vehicles and coal trucks, could accumulate with the leasing of several tracts and become significant. If this occurred, busing or carpooling of employees; fencing high use animal crossing areas; installing warning signs, lights, or mirrors; or other measures may be needed to reduce losses.

Potential Mitigation for Wyoming

Northeast Cow Creek and Atlantic Rim

The final land use decision for coal development on the Northeast Cow Creek subsurface area and the Atlantic Rim surface area defers coal development pending the final disposition of the Savery PRLAs and acquisition of adequate information on elk habitat. The decision as to the acceptability or unacceptability for coal development in the Northeast Cow Creek subsurface area and the Atlantic Rim surface area will be deferred until this same decision is made for the entire elk crucial winter range. (Both tracts occur in the Maximum alternative.)

Pio Tract

For the Pio Tract (High and Maximum alternatives), mitigation methods may require the lessee to employ techniques for wildlife forage manipulation or intensive wildlife habitat management. Habitat recovery may not be completely feasible in the project area; therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the states, or the lessee outside the project area in combination with recovery and replacement methods on suitable lands within the project area. In regard to the above, the lessee would be required to develop a habitat recovery and replacement plan designed to protect and/or enhance wildlife habitat. This plan would be prepared before mining plan approval and shall be prepared in consultation with and subject to approval by BLM, U.S. Fish and Wildlife Service, OSM, and the state of Wyoming.

The habitat recovery and replacement plan would include, but not be limited to:

1. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternative methods which were considered and rejected by the lessee and the rationale for the decision to select the proposed methods. The replacement may include, but is not limited to, the following techniques:

- a. Increasing the quantity and quality of forage available to wildlife
- b. The acquisition of wildlife crucial habitats
- c. Manipulation of wildlife habitat for selected wildlife species
- d. Recovery, replacement, or protection of important wildlife habitat by selected methods (e.g., modifying or eliminating fencing, etc.)
- e. Wildlife watering developments

2. A timetable giving the periods of time that will be required to accomplish the habitat recovery or replacement plan and showing how this timetable relates to the overall mining plan.

3. An evaluation of the final plan by the state of Wyoming. The state will comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If the state has recommended alternate methods, the lessee must consider the state's recommendations and, if the lessee rejects the state's recommendations, the lessee must indicate its reasons as required by provision 2 above. If no state comment is included in the plan, the lessee must verify its consultation with the state

ENVIRONMENTAL CONSEQUENCES

and the plan may be considered without state comment.

4. A habitat analysis of the lease area and those areas considered for off-site mitigation that identifies:

a. Distribution of important wildlife species (game, nongame, sensitive species, species of high Federal interest, and threatened and endangered species)

b. Distribution of important standard habitat types

CULTURAL RESOURCES

Development under all alternatives would impact a wide range of prehistoric and historic cultural resources, both directly through development of particular projects and indirectly as a result of population growth. Overall, these impacts could be mitigated through the requirements of the National Historic Preservation Act of 1966 as amended and 36 Code of Federal Regulations Part 800 (36 CFR 800).

Direct Impacts

Certain kinds of impacts can be predicted as a result of the projected development under all alternatives. Both a data loss and a data gain would occur.

With regard to baseline development, some data loss would result from the methods used to extract cultural data from sites. This is an acceptable trade-off that all archaeology is faced with. Further loss would occur in uncontrolled situations, such as when buried cultural resources are encountered, not identified (or ignored), and subsequently destroyed. There is also a good possibility that cultural resources that are protected by 'avoidance' would be impacted sometime during the project life. This again would result in uncontrollable data loss.

As noted in Chapter 3, there is no reliable information about the number of cultural sites in the region; therefore, the magnitude of these adverse impacts cannot be predicted. In addition, it is not known at this time whether all of the uncontrolled data loss which could result from projected baseline development would be a significant loss either under the No Action Alternative or cumulatively with the proposed new Federal coal leasing under the leasing alternatives. However, given overall mitigation requirements under Federal and state laws, it

is unlikely that any of the potential adverse impacts would be significant.

In the case of new Federal coal leasing, direct effects would occur if a site was located in an area of planned surface disturbance for the mine and its facilities. This may also occur for off-tract actions, such as haul road construction and powerline rights-of-way. Adverse effects from these types of actions are for the most part mitigated by redesigning to avoid the site location.

Avoidance provides the least costly mitigation measure for the coal companies. When this option is not prudent or feasible, data recovery measures are necessary. The measures required to provide for an impacted cultural resource are specifically tailored to the site(s). However, when cultural resources are mitigated through excavation methods, the ultimate data recovery is only as good as current research design, research questions, and data recovery methods permit. Consequently, present state-of-the-art techniques and research questions may not provide all the data that future methods and questions would provide. Cultural information not recovered during physical mitigation efforts could be lost forever.

Overall, cultural resource mitigation measures have been effective when such actions are completed in the initial phase of a new operation (Decker 1981; Keesling 1982). In general, committed mitigation measures will mitigate any impacts to cultural resources in any of the alternatives on coal tracts to an acceptable level. However, one of the past failings noted in mitigation efforts is the use of avoidance strategy. While this is the most desirable approach when it can be used, it has not provided cultural resources with adequate protection through the life of the mine and into the reclamation phases that follow. Mine plans that are developed after leasing need to develop a monitoring/protection plan through end of mine life and final reclamation phases.

Beneficial impacts would occur from development projects under all alternatives. All new coal leases would have a cultural resource survey conducted on them before they could proceed. Information developed from the cultural survey work and any excavations or other data collecting methods would be added to the archaeological record of the region. This, in turn, would greatly enhance specific and overall knowledge of prehistoric activities within the region.

ENVIRONMENTAL CONSEQUENCES

Indirect Impacts

Indirect impacts may also occur and would increase in conjunction with socioeconomic changes and population growth. Population growth would increase casual use on public lands, which, would in turn, increase the rate of vandalism on cultural resources (Williams 1977).

Indirect impacts may also occur to historic cultural resources in communities that experience growth. If this does become a problem, there are several means to mitigate such effects. These include the creation of historic districts in downtown areas that contain historic buildings in the core area; zoning to prevent destruction of older parts of towns and small cities; the implementation (in Colorado) of House Bill 1041 (Land Use Planning); and assistance from other agencies such as the National Trust for Historic Preservation, Energy Impact Funds, and the State Historic Preservation Officer (SHPO). Under the terms of the 1966 National Historic Preservation Act, the SHPO is designated as the official responsible for identification and preservation of historic sites on state and private lands.

Most of the sites already on the National Register in Colorado towns are well known and growth impacts should have no effect on these. In Wyoming, the historic sites listed on the National Register are generally developed as visitor use sites and are certainly well identified. There would be no inadvertent losses from secondary impacts to known sites. Visitor use increases would occur, but monitoring of the sites by the appropriate state agency would limit potential vandalism.

Potential Mitigation

Given past experience with avoidance mitigation, it is suggested that it not be used in relation to coal mining activities because of its past failures to protect cultural resources and because of the protracted time frames in the end of mine life and reclamation phases. Mitigating cultural resources at the outset would best comply with Section 106 of the National Historic Preservation Act of 1966 as amended and 36 CFR 800 and would avoid the difficulties inherent in avoidance altogether (Decker 1981; Keesling 1982).

An archaeological Class III survey (Bureau of Land Management Manual 8111 Section 14) could be required in areas likely to be impacted by surface subsidence. The lessee could be required to define areas with an overburden of 300 feet or less and should provide for archaeological survey of these areas. Archaeological sites located by these

surveys would be mitigated prior to any disturbance. This would be needed for the following tracts: Prairie Dog and Middle Creek (all alternatives), Rattlesnake Mesa and Signal Butte (Moderate through Maximum alternatives), Peck Gulch (High and Maximum alternatives), and Fish Creek and Bell Rock (Maximum alternative).

RECREATION, VISUAL, AND WILDERNESS RESOURCES

Recreation

Urban Recreation

The social, health, and economic benefits of urban recreation become more important as populations increase. Rising transportation costs contribute to people wanting to recreate close to home.

The population within the study area is expected to increase by approximately 64 percent in Colorado and 25 percent in Wyoming by the year 2000 without new Federal coal leasing. Resident demand for urban recreation would increase proportionally with changes in population, with demand for many activities increasing at a faster rate than the population.

The largest percentage increases in population, and thus resident recreation demand, would occur by 1992 under the No Action alternative in the following communities: Meeker, Colorado (167 percent); Diamondville, Wyoming (97 percent); Kemmerer, Wyoming (89 percent); Rangely, Colorado (80 percent); Hayden, Colorado (68 percent); Evanston, Wyoming (65 percent); Dinosaur, Colorado (57 percent); Oak Creek, Colorado (56 percent); Steamboat Springs, Colorado (44 percent); Mountain View, Wyoming (37 percent); Lyman, Wyoming (36 percent); and Craig, Colorado (31 percent). Rawlins, Wyoming, shows a small decline in population by 1992. Between 1992 and 2000, populations are projected to increase at a low to moderate rate except in Uinta County, which will peak in 1995 and then decline below the 1992 level.

Significant demands would be placed on the above communities to provide needed urban recreation facilities, programs, and park areas by 1992. The recreation districts in Rio Blanco County are capable of meeting the needs for Meeker and Rangely, with resident demand peaking in 1995 then declining through 2000. Shortages of some facilities or recreation opportunities would remain in all counties but are not considered significant as long

ENVIRONMENTAL CONSEQUENCES

as the affected communities commit the capital outlays necessary to provide facilities for high demand activities, such as bicycling, swimming, picnicking, golf, and organized sports.

All of the communities in the region would be affected to varying degrees under the four leasing alternatives by new Federal coal leasing, depending upon population fluctuations. (see Economics section). Projected population growth would place additional demands (above those described for the No Action alternative) on many local communities to provide urban recreation facilities, programs, and parks. Under the Low alternative, there should be no significant increases in recreation demand above the baseline. Under the Moderate, High, and Maximum alternatives, Rawlins would receive significant increases in urban recreation demand. Craig and Rock Springs would experience high increases in demand under the High and Maximum alternatives, this being significant when combined with the baseline. All other communities would experience low to moderate increases in demand under the different alternatives except Uinta County communities, where the population is expected to peak in 1995 then decline slightly below the 1992 level. Increases in demand above the baseline for Lincoln County would not be significant under any alternative.

Deficiencies that may exist prior to anticipated increases in demand would be compounded in these communities with new coal leasing. However, all of the communities in the region are aware of future recreational needs, and these needs have been brought forth in their city or county land use or recreation master plans. In most cases, the problem is acquiring the necessary funds to implement these plans. There would generally be a time lag of two to five years to assess need and either develop new facilities or acquire new park land to accommodate the increases in urban recreation demand.

Dispersed Recreation

Both resident and nonresident demand for dispersed recreation is expected to continue increasing under the No Action alternative. Resident use for many types of outdoor recreation activities is estimated to increase proportionally to population increases in the region, although demand for many activities would grow faster than the population. The largest increase in resident demand in Colorado and Wyoming would occur before 1992. Resident demand would then show moderate increases in the region to the year 2000. Nonresident demand is difficult to predict and depends upon many variables, such as the availability of fuel and the cost of transportation. Increased nonresident demand for

dispersed outdoor recreation in the region could result from increased populations in the Colorado Front Range cities and Utah metropolitan areas, as well as from other cities outside the area of this study. Nonresidents account for the majority of recreation use in many areas. Increases in demand are not quantified.

Increased traffic and use of recreation resources would diminish the quality of experiences in the most popular areas. Aesthetic values or the quality of some areas may diminish as a result of intensive use. Increased use of off-road vehicles and overuse of campgrounds, picnic areas, trails, etc., would cause some loss of vegetation and soil. More user conflicts would occur (e.g. snowmobiling versus cross country skiing, off-road vehicle use versus grazing, or development in general versus recreation use). More conflicts would occur with private landowners where access is a problem or boundaries are not well defined. Overall, the quality of unprotected recreation resources would diminish as the region became more urbanized and industrialized and more areas were closed to recreation use.

If budgets declined, more roads and developed recreation areas may be closed. Added restrictions or limits on use may become necessary in more areas, such as heavily used rivers, picnic and camping areas, off-road vehicle use areas, and trails.

National forests, national monuments, and state parks, as well as other public lands and recreation areas, should see continued increases in use. However most designated parks and recreation areas should be able to accommodate increased use, except on holiday weekends when demand exceeds supply.

If funding was not made available to provide new developed recreation sites and manage nondeveloped recreation resources, then loss of quality recreation opportunities and experiences and, ultimately, loss of social and economic benefits that outdoor recreation provides could occur.

The four leasing alternatives would add to the impacts noted above. Approximately 13,281 acres of accessible public lands would be removed from public recreation use in the region under the Low alternative; 17,842 acres under the Moderate alternative; 25,823 acres under the High alternative; and 33,104 acres under the Maximum alternative (20,018 acres in Wyoming and 13,086 acres in Colorado). Under the Maximum alternative, this would affect less than 10 percent of the accessible public lands.

All recreation opportunities would be lost in all of the areas leased. Impacts associated with the removal of accessible public land are not considered

ENVIRONMENTAL CONSEQUENCES

significant on a regional basis but may have notable local impacts, such as diminishing recreation opportunities close to communities. Rawlins, Wyoming, which would experience the largest increase in demand, would be particularly affected. The Iles Mountain Tract in Colorado has 960 acres of public land with high quality hunting opportunities which would be lost. The Atlantic Rim, Northeast Cow Creek, Indian Springs, and Pio tracts also have outstanding hunting opportunities (deer, elk or antelope) which would be lost when the tracts are developed. Most hunting would probably be displaced into adjacent areas. Private hunting opportunities would also be displaced in many instances because of the mix of private and public lands.

As wildlife habitat was lost, resulting in losses of game animals (see Wildlife section), hunter success for deer and elk in these areas would decline. Although limits are placed on the number of nonresident permits in Wyoming, the increased population would increase the numbers of resident hunters. Larger numbers of hunters would be seeking a fixed or declining game population and facing a decline in the availability of areas in which to hunt. Other areas, such as national forests, would have to absorb increased use. Finally, the sights and sounds of mining itself would lower the quality of the recreation experience in areas adjacent to the mines.

Popular areas offering high quality fishing or hunting would be more intensively used and capacity may be exceeded, resulting in more restrictions on use (closing areas, limiting permits, or restricting numbers of users in certain areas to protect the resource base). Those who had been experiencing solitude while engaged in a certain activity may encounter more people in the most popular areas, thus lowering the quality of their experience. This impact is significant to the recreationist who is sensitive to increased use, and it becomes more important as more areas are closed for the major portion of an individual's lifetime. This would be particularly evident in areas close to communities with large population increases (Rawlins, Craig, and Rock Springs). Vandalism, littering, and conflicts with other users and landowners would also increase.

Holiday weekends and short season activities with high participation rates prompt overcrowding, and this situation would continue. As public agencies become aware of constant overcrowding of their facilities, additional accommodations should be provided. This is becoming more difficult however, as budgets decline and development, operation, and maintenance costs rise. The national forests, national monuments, state parks, wildlife refuges, historical sites, and other recreation areas would see increased use. These areas should be capable of accommodating this increased use if funding re-

mains adequate. Otherwise significant impacts may occur, such as closing developed recreation areas (picnic or campgrounds), closing access roads, and, ultimately, denying recreation opportunities to the public.

Development of the Iles Mountain Tract (High and Maximum alternatives) would degrade the aesthetic quality of the adjacent Yampa River corridor (Little Yampa Canyon). Sights and sounds (dust, blasting, mine equipment, railroad, surface disturbance, etc.) from mining operations would diminish the quality of the environment and the outstanding quality of the recreation experience sought by 'flatwater' floatboaters on this portion of the Yampa River. This impact is significant to those who recreate on the river and would become more important over time as demand and use increased for this diminishing recreation resource. The Signal Butte (Moderate alternative) and Horse Gulch (Maximum alternative) tracts would also diminish the quality of the Little Yampa Canyon due to sights and sounds of mining operations along the southern boundary of these tracts. The impacts from these two tracts is considered to be insignificant and would be short term. As more development of rivers occurred in the region and demand for recreational use of rivers increased, the rivers that remain in a natural state would become more important as a recreation resource.

The eastern rim of the Continental Divide passes near the Wild Horse Draw, Corral Canyon, and Atlantic Rim tracts. The proposed Continental Divide Trail would follow this rim but would not be significantly impacted by the proposed mines, although they would be visible at a distance of one to two miles if the trail was developed (Moderate alternative).

Off-road vehicle use is expected to increase on public lands. Those areas normally available for off-road vehicle travel are particularly susceptible to destruction of vegetation and increased soil erosion. More restrictions may be needed for off-road vehicle use, but this impact cannot be quantified.

As environmental and socioeconomic conditions changed in the region, so would recreation use patterns. As new individuals and families moved into the region to live, they would bring a wider variety of leisure interests and/or different intensity of participation (Warder 1979). In order to properly assess demands or needs, continuing research and surveys should be conducted so that proper management decisions and recreation development would take place to mitigate impacts and enhance this increasingly important resource.

ENVIRONMENTAL CONSEQUENCES

Unavoidable Adverse Effects

Increased pressure placed on urban recreation as a result of increased demand from population growth would be unavoidable. It would be significant in Carbon County under the Moderate, High, and Maximum alternatives and in the Craig and Rock Springs areas under the High and Maximum alternatives in 1995 when combined with the baseline.

Short-Term Use vs. Long-Term Productivity

Short-term use resulting directly from mining development and indirectly from increasing pressure on, and use of, recreation resources should not affect the long-term productivity of these resources. Extended and severe overuse of the recreation resource would create the possibility for long-term productivity decline.

Irreversible or Irretrievable Commitments of Resources

Any loss in quality of a recreation experience and opportunities denied due to closed areas, increased participation, and increased restrictions would be an irretrievable loss to participants.

Potential Mitigation

The financial strain placed on affected regional communities to provide public recreation facilities could be eased by state and Federal funding in the form of public use facility grants. Energy companies could be encouraged to cooperate with local governments to meet recreation needs. Other sources of funding, such as formation of recreation districts, could be sought to provide facilities and programs.

Funding could be directed to county, state, and Federal agencies with outdoor recreation responsibilities within the study region to intensify management of public lands for recreation, provide facilities and management personnel, make needed recreation opportunities available, and ensure the welfare and safety of the public. Continuing research and surveys could be conducted to provide necessary information for assessment of demands or needs so that impacts can be mitigated and proper development or management of important recreation resources will occur.

Visual Resources

As populations increased under the No Action alternative, more urbanization would occur in and near existing communities. In many cases the visual character of the rural ranching landscape would be changed to one of urbanization or industrialization. New roads, railroads, powerlines, ancillary facilities, and housing developments, among other things, would be needed, which would increase adverse change to the natural landscape character. Alteration of the natural landscape in those areas with medium to high visual sensitivity or high scenic quality would cause the most severe adverse changes. Development in areas with medium sensitivity could be considered as an important impact, while development in high sensitivity areas could have significant impacts. In both cases, the natural integrity of the environment would have been changed to an urban or industrialized environment.

Projects planned or now being developed would disturb or alter approximately 74,777 additional acres between 1983 and 2000 without new Federal coal leases. Table 4-23 shows that total acres disturbed in the region by 2000 would be 236,725 without new Federal leasing. These totals include coal, oil and gas, uranium, oil shale, trona, pipelines, water projects, and associated secondary disturbances such as housing and new roads. Some of these activities would not be as visually obvious as surface mining. Therefore the visual degradation suggested here may not be as great as the number of acreage disturbance figures indicate.

The continuing process of reclamation has not decreased the severity of visual disruption of the landscape in the study region but should be having an effect by the year 2000. Some of the areas being rehabilitated now may have regained their natural character by that time. It generally requires 20 to 50 years for natural vegetation to re-establish to the point where all elements of the original landscape (line, form, color, and texture) are attained and the area appears as it did before it was altered. However, the overall quality of the region's visual resources would continue to diminish with each new development, especially those which alter the landscape over large areas, e.g., surface mines. Size, location, vegetation, visual sensitivity, scenic quality, time, amount of disturbance, and reclamation potential, among other variables, would ultimately determine the severity of any single development or the cumulative effects of all the developments in the region.

The most significant visual impact under the four leasing alternatives would arise from the actual sur-

VISUAL RESOURCE ANALYSIS FOR PROPOSED LEASE AREAS

Tract	1983	1992	1995	2000	EML	VRM Class	Sensitivity **	Short-Term † Impact	Long-Term †† Impact	Long-Term VRM Class Change	Total Offsite * Acres Disturbed	Alternatives Represented
Colorado Region	19,411	33,860	38,115	41,980		II to V	Low to High	Medium to High	Low to High	---	---	No Action
Wyoming Region	142,537	169,576	174,448	194,745		II to V	Low to High	Medium to High	Low to High	---	---	No Action
Total	161,948	203,436	212,563	236,725		---	---	---	---	---	---	---
Onsite Acreage Disturbed - VRM Class V												
Deadman *	0	(80)	0	0	0	IV	Low	Medium	Low	0	0	Low to Maximum ↓
Leucite Hills	0	166	469	974	3,600	IV	Low	Medium	Low	0	103	
Point of Rocks	0	112	388	848	2,780	IV	Low to Medium	Medium	Low to Medium	0	38	
Tract 98 *	0	(165)	(165)	(165)		III	Medium	Medium	Medium	0	0	
Prairie Dog	0	40	40	40	40	IV	Low to Medium	Low	Low	0	165	
Little Middle Creek *	0	(700)	0	0	0	III & IV	Medium to High	Medium	Medium	0	0	
Middle Creek	0	10	10	10	10	II & IV	Medium to High	Medium	Low	0	4	
Low - Total	0	328	907	1,872	6,430	---	---	---	---	---	310	
Atlantic Rim	0	237	948	2,133	7,110	II	Medium to High	High	High	III	930	Moderate to Maximum ↓
Byrne Creek	0	84	306	676	2,230	III & IV	Medium	Medium	Medium	0	66	
Corral Canyon	0	68	296	676	2,272	III	Medium to High	High	Medium	0	468	
Wild Horse Draw	0	135	540	945	---	III	Medium to High	High	Medium	0	650	
Rattlesnake Mesa	0	40	40	40	40	II & IV	High	Medium	Medium	0	87	
Signal Butte	0	210	537	1,082	123	IV	Low	Medium	Low	0	386	
Subtotal	0	774	2,667	5,552	11,775	---	---	---	---	---	2,587	
Moderate - Total	0	1,102	3,574	7,424	18,205	---	---	---	---	---	2,897	
Onsite Acreage Disturbed - VRM Class V												
Pio	0	164	512	1,092	2,600	IV	Low	Medium	Low	0	320	High to Maximum ↓
Winton	0	43	43	43	43	IV & V	Low	Low	Low	IV	301	
Peck Gulch	0	40	40	40	40	IV	Medium	Medium	Low	0	161	
Iles Mountain	0	150	300	550	1,100	III & IV	Medium to High	High	Medium	0	120	
Fish Creek	0	200	300	100	100	III & IV	Medium	Medium	Low	0	90	
Indian Springs	0	100	100	100	100	IV	Medium to High	Medium	Low	0	169	
Subtotal	0	697	1,295	1,925	3,983	---	---	---	---	---	1,161	
High - Total	0	1,799	4,869	9,349	22,188	---	---	---	---	---	4,058	
Northeast Cow Creek	0	40	40	40	40	III & IV	Low	Medium	Low	0	646	Maximum ↓
Bell Rock	0	50	50	50	50	II, III, IV	Low to High	Low	Low	0	111	
Williams Fork	0	176	563	1,208	3,917	III & IV	Medium to High	Medium	Medium	0	95	
Lay Creek	0	181	376	701	2,066	IV	Low	Medium	Low	0	430	
Horse Gulch	0	121	340	705	1,143	IV	Low to Medium	Medium	Low	0	113	
Subtotal	0	568	1,369	2,704	7,216	---	---	---	---	---	1,395	
Maximum - Total	0	2,367	6,238	12,053	29,404	---	---	---	---	---	5,453	
Region												
Cumulative												
Total Acres Disturbed	161,948	205,803	218,801	248,778	---							Maximum

* Acreage in parentheses for these tracts is included in the No Action alternative and is not part of other alternative totals.

** Low = not highly visible, seldom seen; Medium = viewed as background; and High = highly visible from well traveled roads or high scenic quality.

† Short-term landscape modification allowed for the class except Prairie Dog, Winton, and Bell Rock tracts. Low = no class change, Medium = Class change to V Low Impact, and High = Class change to V significant Impact, short term.

†† Long-term Impacts are 20 - 50 years after successful reclamation. Low = No change in class or change will not be evident in the long term due to successful reclamation. Medium = Landscape change to Interim VRM Class V until after successful reclamation. High = Significant or permanent change in the landscape (VRM class change).

• Total disturbance at end of mine life. Includes direct and indirect disturbance some of which will cause a permanent landscape change (i.e. housing, roads, utilities, and other services).

ENVIRONMENTAL CONSEQUENCES

face mining of coal. From the time construction began, an intrusion on the landscape would create a strong contrast with the basic elements of form, line, color, and texture. This would result in a visual resource management (VRM) classification change from Class II, III, and IV to Class V until after successful reclamation.

Table 4-23 indicates that long-term changes to the characteristic landscape would occur on Iles Mountain, Little Middle Creek, Williams Fork, and Rattlesnake Mesa tracts in Colorado and Atlantic Rim, Byrne Creek, Wild Horse Draw, Corral Canyon, Point of Rocks, and Tract 98 in Wyoming. Determination of significance is based on visibility or sensitivity to changes in the landscape. The only significant impact would occur on the Atlantic Rim Tract, where the original VRM Class II rating would be lowered to VRM Class III in the long term because the vegetation would change, thus changing the elements from the original landscape. It is also important to note that the high scenic and aesthetic quality of the Yampa River corridor (Little Yampa Canyon) would be lowered in the long term until native vegetation was reestablished. The Iles Mountain tract is highly visible from the Yampa River as well as state highway 13/789. Disturbance from surface mining and the proposed rail spur would diminish the integrity of this portion of the river.

Additional landscape disturbance would occur offsite as a result of construction of access roads, rail spurs, powerlines, pipelines, urban development, and other structures or development. These would place intrusions on the landscape which would contrast with the basic elements of form, line, color, and texture. Table 4-23 shows that off-site acres disturbed, both direct and indirect, would be 310, 2,897, 4,058, and 5,453 acres under the Low, Moderate, High, and Maximum alternatives, respectively. Some of this disturbance, e.g., urban development and permanent roads or railroads, would not be reclaimed. Approximately twice as much disturbance would occur in Wyoming as in Colorado. Many of these disturbed areas would represent an irreversible commitment of visual resources, with unknown potential impacts.

The greatest visual impacts would be experienced where the region's major transportation routes bisect the study region. The well-traveled highways in Colorado are State Highway 13/789 and U.S. Highway 40. Interstate 80, U.S. 191, U.S. 189, and State Highway 789 in Wyoming allow viewing of active and inactive mining areas and other developments. Visual sensitivity in table 4-23 indicates the visibility of each tract in relation to transportation routes or scenic quality.

The original VRM classification of the disturbed areas generally cannot be re-established in the short term. Reclamation regulations require that vegetation be re-established and the land mass be recontoured. Successful reclamation usually does not occur until about 12 years after mine life.

Once reclamation has begun and soils are contoured, the first type of vegetation generally planted is grasses. This would decrease the visual contrast so that only the elements of line, color, and texture of the vegetation feature would contrast with the surrounding natural plant communities. It would take approximately 20 to 50 years for the original vegetation types to regain a foothold on the reclaimed Federal surface. In the long term, a mined area could be returned to its original VRM classification. If seeding of natural vegetation or use of native species plugs from the surrounding area were utilized, plant succession would be accelerated, thus restoring visual quality sooner.

Where the mined surface is under private ownership, the postmine land use may be changed. For example, if an owner wished to change a previous mountain shrub community into livestock pasture use and met the criteria set forth in regulations, the shrub community would not be reclaimed to its original vegetation type. Therefore, it is possible that a premining VRM classification may never be re-established. On the other hand, in an area that has limited vegetation cover, diversity, texture, or color, or that is already disturbed, a postmine land use change to pastures (if possible) may actually increase the scenic quality, thus possibly upgrading a premining VRM classification.

Development of subsurface tracts would not be as visually obvious as those to be surface mined. For example, if the only disturbance consists of mine facilities which are placed away from sensitive or high quality scenic areas, they may not be obvious intrusions on the landscape and may even meet VRM Class IV objectives.

Unavoidable Adverse Effects

The Atlantic Rim Tract would be reduced from VRM Class II to VRM Class III under the Moderate through Maximum alternatives.

Short-Term Use vs. Long-Term Productivity

The short-term use of mining development on the Atlantic Rim Tract would lower the present VRM Class II rating to Class III in the long term because the vegetation would change, thus changing the elements of the original landscape. Under all alternatives, areas where permanent developments took

ENVIRONMENTAL CONSEQUENCES

place, such as urban developments, roads, or utilities, would sustain unknown potential impacts in the long term.

Irreversible or Irretrievable Commitments of Resources

Portions of the Atlantic Rim Tract would exhibit irreversible landscape change as a direct result of vegetation type changes. Under all alternatives, new urban developments, permanent roads, railroads, utilities, and service facilities would constitute an irreversible commitment of visual resource Class II, III, and IV areas, with unknown impacts.

Potential Mitigation

To provide the same visual quality as existed during the premining period, all disturbed areas would be returned to their original form and native vegetation communities as soon as possible. To accelerate the return of native vegetation, plugs from the surrounding area could be planted to enhance and accelerate plant succession. Islands of native vegetation could be left if possible and unnecessary disturbance of areas not essential to mine operation could be avoided. Development in areas of high scenic quality or high visual sensitivity could also be avoided.

For Northeast Cow Creek Tract, ventilation shafts and access roads could be placed far enough back from the Deep Gulch drainage so that these facilities would not be seen from the drainage.

Wilderness Values

Wilderness use would increase with the expected increase in population and the growing awareness of wilderness. Use of existing wilderness areas in the study region would continue to increase, as would use of any areas added to the system. As use increased, so would conflicts involving recreation, livestock, pets, loss of opportunities for solitude, etc. This would require greater efforts to protect or restore wilderness values while providing a range of experience opportunities.

If more acres of wilderness were designated, capacity would be expanded and more wilderness use would be accommodated in the region. Protection of wilderness recreation opportunities and experiences would also be enhanced. However, new restrictions or limits may be required in popular areas to maintain the solitude and range of social and recreational experiences expected in a wilderness setting.

There are no wilderness areas or wilderness study areas in or adjacent to any of the proposed lease areas. The areas which may be recommended for wilderness designation, as well as those which would be dropped from consideration, would experience increased use due to coal-related population increases. No significant impacts are anticipated on existing wilderness or wilderness study areas.

LAND USE

The disruption of existing land uses caused by future development would have both direct and indirect impacts. Direct impacts are those which cause a change in existing land use, whereas indirect impacts involve economic impacts resulting from this conversion as well as the actual problems associated with rapid urbanization. The Economics section details economic impacts.

Agriculture and Other Land Uses

The major change in land use under the No Action alternative would be the conversion of rangeland by the development of mineral resources. This activity would remove both native vegetation and cropland from approximately 236,725 acres by the year 2000, resulting in a 46.2 percent increase in surface disturbance between the years 1983 and 2000. This takes into account the reclamation that would occur during this time period. The majority of activity would occur in Wyoming, 78.4 percent of the total disturbance, with the remaining 21.6 percent taking place in Colorado.

As a result of the conversion of rangeland to other uses under the No Action alternative, approximately 14,508 AUMs per year would be out of production by the year 2000. Depending upon the type of activity replacing this rangeland (i.e., urban development versus mineral extraction), production would not resume in the long term on a small portion of these lands (i.e., those converted to urban use). The loss of these AUMs would be a direct loss to the regional livestock industry as well as a loss to individual ranching operations.

The use of Federal lands by livestock operators is granted through grazing permits or leases that are, in some cases, an integral part of the ranching operation. On permit grazing land, the appropriate controlling agency has the authority to curtail or temporarily suspend AUMs to allow multiple use, such as coal development. Therefore, the loss of

ENVIRONMENTAL CONSEQUENCES

Federal AUMs or state grazing leases would not result in compensation, whereas the loss of private AUMs would return surface disturbance compensation to private individuals.

The number of AUMs which would be out of production as a result of the projected activities and the proposed coal leasing would be insignificant to the regional livestock industry. Approximately 23,211 AUMs per year would be out of production, which would account for a loss of approximately 1 percent of the regional AUM production. Table 4-24 indicates the number of AUMs affected by each alternative.

The AUM loss was calculated by determining the number of acres needed for one AUM within the subject area and dividing it into the number of affected acres. It is assumed that affected acres for a surface mine would be the entire tract plus any off-site disturbance, pending detailed mine plans. AUM losses for underground tracts reflect only disturbed acres.

Impacts to individual ranching operations would be significant under the High and Maximum alternatives. The threshold for significance is assumed to be 10 percent or more of one's total operation. With the leasing of the Pio Tract under the High alternative, in combination with the existing Beans Springs PRLA projected for future development, the Salt Wells Livestock Company stands to lose approximately 16 percent of their total operational AUMs. Two other individuals would experience impacts to their operations with the leasing of the Williams Fork Mountain Tract under the Maximum alternative. One rancher would lose 85 percent of his operation, while the other individual would experience a 12 percent loss.

A cumulative loss of 11 percent would affect a rancher with the leasing of four tracts in Colorado. The first tract, Signal Butte, is included under the Moderate alternative and is carried through to the Maximum alternative, where the additional impacts are incorporated through the leasing of the Horse Gulch, Lay Creek, and Williams Fork Mountain tracts. This 11 percent loss would not occur with the leasing of any one of these tracts but would with the leasing of all four under the Maximum alternative.

There are other considerations involved in determining significant impacts to individual ranching operations. There are four critical lambing areas used by three individuals located within the Signal Butte and Lay Creek tracts. These tracts are being considered under the High and Maximum alternatives, respectively. The loss of critical lambing areas would represent an impact greater than the AUM losses alone would suggest.

All three individuals utilizing these critical lambing areas have been tentatively identified as qualified surface owners. A qualified surface owner has the choice of being compensated for impacts occurring to his operations or not permitting mining if the impacts involve private holdings. For these reasons, impacts resulting from the disruption of these lambing areas are considered insignificant.

However, two of the individuals affected by AUM losses would not meet the criteria established for qualified surface owners: Salt Wells Livestock Company and F. Self. These two operators would stand to lose 16 and 85 percent of their operations, respectively. The impacts to their operations resulting from an AUM loss are considered to be significant. For information regarding economic losses, see the Economics section.

Development under the No Action alternative would also cause losses of watering facilities normally used by livestock. This would disrupt distributional patterns used to meet proper management goals and could cause overuse to adjacent areas.

Post Oak Spring, located within the Iles Mountain tract boundary, is the only watering facility on the east side of one grazing allotment (#4603) and is therefore essential to livestock and wildlife. Livestock would be displaced for a 1-1/2 mile radius around the eastern portion of the tract, resulting in a loss of 300 AUMs, or 13 percent of the total allotment. Additional impacts would also occur to this allotment, based on the location of tract disturbance. Cattle would essentially be displaced from the entire tract during the life of the mine, resulting in a loss of 377 AUMs, or 17 percent of the total allotment. Therefore, a cumulative loss of 677 AUMs, or 30 percent of the total allotment, would occur, causing a significant impact on carrying capacity.

Disturbance of cropland under the No Action alternative is estimated to be 2.6 percent of the total surface disturbance. Of this, 2,020 acres would be disturbed in Colorado and 3,895 acres in Wyoming (see Vegetation section). An additional 2,599 acres would be disturbed under the Maximum alternative, resulting in a total disturbance, including baseline, of 6,494 acres. This accounts for less than 1 percent of the regional total and is therefore considered insignificant.

Approximately 5,100 acres of woodland (conifers) would be disturbed by the year 2000 under the No Action alternative. An additional 226 acres would be disturbed as a result of the Maximum alternative. The majority of this disturbance would be a result of urban expansion and recreational development and would not cause a significant impact to the regional total.

TABLE 4-24

LOSS OF ANIMAL UNIT MONTHS PER YEAR

Proposed Alternative	AUMs on Tract *			Total AUMs on Tract	AUMs Off-Tract **		Cumulative	No Action †	Total	% of	
	Federal	Private	State		Off-Tract	Secondary				Total	% of Region
Low Alternative	398	473	32	903	18	10	931	14,508	15,439	6.0	0.9
Moderate Alternative	1,259	2,190	41	3,490	172	42	3,704	14,508	18,212	20.3	1.1
High Alternative	1,641	3,259	41	4,941	214	80	5,235	14,508	19,743	26.5	1.2
Maximum Alternative	2,225	5,928	121	8,274	313	116	8,703	14,508	23,211	37.5	1.4

* Indicates the number of AUMs lost per year from peak construction to EML

** Indicates the number of AUMs lost per year by EML

† Indicates the number of AUMs lost per year by the year 2000

ENVIRONMENTAL CONSEQUENCES

Disturbance resulting from baseline and the proposed alternatives would also affect a number of different habitat types that support a variety of different wildlife species. For impacts associated with this disturbance, see the Animal Life section.

The site specific analysis for Tract 98 in Wyoming identified the possibility of allowing the coal extraction pit to remain open. If the pit remained open, a loss of approximately 80 acres of livestock grazing land would result. During the review of the mining and reclamation plan, a determination will be made by the Wyoming Department of Environmental Quality and the Office of Surface Mining as to whether the tract meets requirements allowing the pit to remain open.

There could be some problems in developing certain oil and gas leases under both the No Action and the four leasing alternatives (see Geology section).

Rights-of-Way

There are a number of rights-of-way associated with each tract under every alternative. The costs for any necessary relocation would be absorbed by the lessee if Federal rights-of-way were involved. (Conditions for relocating any other rights-of-way would depend on the specific terms of each right-of-way agreement.) It is assumed, based on the ease of relocation, that no conflicts would occur from existing minor rights-of-way. For this reason, minor rights-of-way are considered insignificant and will not be discussed further. Major rights-of-way that do not interfere with development or extraction of the recoverable resources are also insignificant.

There are, however, five major rights-of-way that would preclude the development of some of the recoverable coal resources within three proposed coal tracts. These tracts are Point of Rocks in Wyoming and Williams Fork Mountain and Horse Gulch in Colorado.

The Point of Rocks Tract is included in the Low alternative and involves three major rights-of-way which, if not relocated, would preclude development of approximately 1.5 million tons of coal out of a total of 17.5 million tons recoverable. Relocation, if required, would be expensive, with the cost being absorbed by the lessee. It should be noted that to achieve maximum economic recovery, the BLM authorizing officer may require the rights-of-way to be moved. However, that determination has not yet been made. The rights-of-way include a 500 Kv powerline (W-60664), a water line (W-34561), and a 36-inch diameter interstate gas pipeline (W-70865). The holders of these rights-of-way are

Idaho Power and Light, Pacific Power and Light, and Colorado Interstate Gas, respectively.

This conflict is carried through all other alternatives to the Maximum alternative, where two additional tracts in Colorado have major rights-of-way. The Williams Fork Mountain tract contains a 230 Kv power transmission line that would preclude development of approximately 0.5 million tons of coal out of a total of 39 million tons recoverable. The Horse Gulch tract contains a 345 Kv power transmission line which would preclude the development of approximately 7,000 tons of coal out of a total of 7.1 million tons recoverable. Since rerouting the powerlines would cost more than the value of the coal, the District Mining Supervisor has indicated that maximum economic recovery can be achieved without relocation of the rights-of-way. (Memorandum ODM 3-1-37, January 25, 1983.)

Withdrawals and Land Exchanges

Impacts to withdrawals and land exchanges under the No Action alternative are impossible to determine at this time. However, there are eight withdrawals located within five proposed Colorado coal tracts: Prairie Dog, Middle Creek, Iles Mountain, Bell Rock, and Horse Gulch. Two Bureau of Reclamation withdrawals associated with the proposed Juniper Springs Cross Mountain Power Project, PLO-3735 and PLO-3736, are located within three of these tracts: Bell Rock, Iles Mountain, and Horse Gulch. The Bureau of Reclamation has requested revocation of these withdrawals, and it seems certain they will, in fact, be revoked.

A withdrawal involving the Federal Project 2773 (Oak Creek Power Project - Childress Reservoir) encompasses parts of the Middle Creek Tract proposed under the Low alternative. This tract is also affected by a high water surface elevation. BLM has coordinated with the Federal Energy Regulatory Commission, and it has been determined that the standard powersite stipulation (Form 3730-1, Dec. 1975) will be incorporated into the lease. Since the high water line would not impact any facilities or the portal location and the possibility of subsidence occurring is considered remote, the impacts of this withdrawal are considered insignificant.

The remaining withdrawals are powersite withdrawals controlled by the Federal Energy Regulatory Commission located within the Middle Creek, Prairie Dog, Iles Mountain, Horse Gulch and Bell Rock tracts. To comply with the Federal regulation (43 CFR 3501.3-2) requiring consultation with the government agency having control of the withdraw-

ENVIRONMENTAL CONSEQUENCES

al, the Federal Energy Regulatory Commission has been notified. It has been determined that the standard powersite stipulation form will be incorporated into the lease if these tracts are leased for coal development.

Four of the powersite withdrawals (Middle Creek, Prairie Dog, Iles Mountain, and Bell Rock tracts) are considered insignificant because of the relationship between the lands covered by the withdrawal and the surface disturbance. However, impacts resulting from the withdrawal within the Horse Gulch Tract may be significant. The affected area within the tract boundary has already been identified as unsuitable for surface occupancy due to existing flood plains. The extent of lateral movement of water from the elevated water table into adjacent bedrock from the reservoir cannot be predicted; consequently, potential impacts to coal mining cannot be determined at this time.

There are two land exchanges underway in Wyoming, one involving the Point of Rocks Tract and the other the Corral Canyon Tract. These proposed leases are introduced under the Low and Moderate alternatives, respectively.

The U.S. Fish and Wildlife Service is currently working with the Rock Springs BLM District Office on a Memorandum of Agreement (#14-16-0006-83-92) covering the exchange of 1,398 acres within the Point of Rocks Tract. If the exchange was completed, the tract's Federal recoverable coal reserves would decrease from 13.6 to 4.1 million tons.

The land exchange affecting the Corral Canyon Tract, the Corral Canyon--Grand Teton National Park exchange, is a proposal for an exchange of lands between Rocky Mountain Energy Company (RME) and the Federal government. The government would acquire 754.95 acres of private land within Grand Teton National Park in exchange for 1,000 acres of Federal land that is intermingled with RME in the checkerboard land pattern. This would give RME a solid block of land as a logical mining unit. This exchange is being actively considered. However, it would involve lands which have been proposed for potential coal development. If the exchange was accomplished, the coal tract would be dropped from further consideration for coal leasing. This would decrease the proposed recoverable coal reserves by 72.2 million tons under the Moderate, High, and Maximum alternatives.

Occupied Dwellings

The number of occupied dwellings which would be affected under the No Action alternative is im-

possible to determine at this time. However, there are six permanent residences within the boundaries of five proposed coal tracts--Peck Gulch, Fish Creek, Bell Rock, Lay Creek, and Williams Fork Mountain. The two occupied dwellings located within the Williams Fork Mountain and Lay Creek tracts are positioned in identified flood plains that are unsuitable for mining. Therefore, no impacts are anticipated.

The two occupied dwellings located in the Bell Rock Tract and the single residence within the Peck Gulch Tract are protected from subsidence, which is generally associated with underground mining, by mitigation which would be implemented at the mine planning stage. However, this protection may result in a loss of mineable coal.

The area within and surrounding the Bell Rock Tract has been undergoing a gradual land use change from agricultural to residential because of its location in relationship to the community of Craig and the ease of access. This land use change could be halted because of the impacts of mining.

The sixth permanent residence that would be impacted as a result of coal development is located in the Fish Creek Tract. If the lessee did not purchase the location, regulations would protect the resident. This would preclude the development of approximately 150,000 tons of the total 3.5 million tons of surface recoverable coal reserves and exclude 10 acres of surface area. The residence would not be affected by subsurface mining, based on the presence of sufficient overburden depths.

Existing Land Use Plans and Policies

The conversion of cropland and rural lands to urban and industrial uses would result in conflicts with state and county policies. These policies encourage the maintenance of such lands and discourage development that would convert agricultural croplands to other uses. Therefore, development guidelines need to be established in local land use plans to minimize this impact and direct development to less productive lands. In doing so, local governments also need to comply with state laws involving zoning and planning. These state laws encourage new urban development adjacent to and contiguous with existing communities to the point where carrying capacities of these urban areas are not exceeded. Without careful planning and the phased implementation of energy development in each state, several communities may experience adverse impacts associated with rapid urbanization by 1992.

ENVIRONMENTAL CONSEQUENCES

Approximately 3,332 acres would be required for urban expansion of existing communities under the No Action alternative between the years 1983 and 2000. An additional 1,044 acres would be needed to accommodate rapid urbanization under the Maximum alternative. The communities of Craig, Meeker, Steamboat Springs, Rawlins, Kemmerer, Evanston, and Rock Springs would experience varying degrees of growth.

The majority of the tracts located in Wyoming are affected by the checkerboard land ownership pattern that was brought about by the numerous railroad grants issued in the late 1800's. In order to delineate economical mining units, tracts had to include large portions of private estates within their boundaries. If the Federal coal reserves were leased and developed, it would then be economically feasible to develop the private coal within the proposed tracts.

Unavoidable Adverse Effects

The following adverse environmental impacts could not be avoided should the proposed action be implemented. These impacts are based on the significant impacts which have been identified in the narrative:

1. The conversion of ranch lands to mining uses and the loss of AUMs associated with this conversion would force two individuals out of business under the High and Maximum alternatives. The leasing of the Pio Tract under the High and Maximum alternatives would result in a 16 percent loss to one operator. Development of the Williams Fork Mountain Tract, introduced under the Maximum alternative, would result in a loss of 85 percent of the second individual's ranching operation.
2. Three major rights-of-way on Point of Rocks Tract would have to be relocated, or development of 1.5 million tons of coal would be precluded.
3. The displacement of livestock within allotment #4603 with the development of the Iles Mountain Tract would result in a significant impact to the carrying capacity of that allotment. Approximately 677 AUMs would be lost during the life of the mine resulting in a 30 percent cut in carrying capacity.

Short-Term Use vs. Long-Term Productivity

The AUM losses associated with individual ranching operations would cause short-term significant impacts. However, the productivity of these disturbed areas would return to original conditions in the long term.

Irreversible or Irretrievable Commitments of Resources

Irreversible commitments of existing land use resources would involve the loss of the two ranching operations under the High and Maximum alternatives. The owners of these operations may be forced to seek other employment during the life of the projects. The probability of the ranchers ever re-establishing their operations after 20 to 30 years is questionable.

Potential Mitigation

The following potential measures could be used to minimize the impacts on land use resulting from the proposed action:

1. Impacts on farmlands or croplands could be lessened if communities directed urban expansion to less desirable lands adjacent to existing urban areas.
2. Post Oak Spring, located inside the Iles Mountain Tract, is the only watering facility on the east side of allotment #4603 and is essential to livestock and wildlife. Requiring the coal lessee to pipe water from the spring to the portion of the allotment outside the tract or to provide another source of water in this area through the life of the mine would minimize the loss of this spring.

ECONOMICS

Impact Analysis Guidelines

The projections presented here represent the maximum (either beneficial or adverse) outcome that would be expected under each of the alternatives. Appendix 3 presents a description of the methods of analysis used.

ENVIRONMENTAL CONSEQUENCES

Specific economic projections more than 20 years into the future are not feasible because of unforeseeable changes in technology, consumer preferences, national policies, and other variables. Therefore, the quantitative analysis extends only to the year 2000 and does not include the later period of the mine lives. The only change in proposed development that would occur during that period--on the Signal Butte tract--is included in the descriptions of the effects.

Considerable economic growth is projected in the region during the 1983 to 1992 period under the No Action alternative. However, much of this growth, particularly in Colorado, depends on a few projects - the Aquatrain pipeline and the Federal oil shale tracts. If these projects do not develop as expected, the growth will be only about half as large. The Bonanza power plant in Utah and its associated Deserado coal mine; a continuing increase in oil and gas activity, mainly in the Rangely and Dinosaur areas; winter recreation around Steamboat Springs; planned coal mine expansions; and projected new coal mines account for the other half.

Natural gas processing plants in Lincoln County and fertilizer production near Rock Springs are expected to spark a small economic growth in the southwestern Wyoming part of the region. Continued development is projected to occur in the Overthrust Belt oil and gas area of Uinta and Lincoln counties. Activities in other parts of the economy--coal, uranium, trona, and agriculture--are expected to increase slightly or remain stable during this period.

A sharp decline in coal and uranium mining since 1980 has depressed the economy of Carbon County, which is heavily dependent on the mining and timber industries. Population in the county is estimated to have declined 21 percent between 1980 and 1983. This condition is not expected to ease appreciably until the later 1990's, and would continue under the Low Leasing alternative as well as the No Action alternative, because no tracts in this leasing alternative would provide employment opportunities for Carbon County.

Except for oil shale development in Rio Blanco County and portions of Utah adjacent to Rangely and Dinosaur, slower economic growth is anticipated in the region during the later 1990's. A gradual increase in coal production and oil and gas will take place in Carbon County, and oil and gas activity in the Overthrust Belt will stabilize.

Employment and Income

Employment increases of about 4,000 projected for Rio Blanco and Routt counties by 1992 under the No Action alternative (table 4-25) are mainly associated with the Bonanza power plant, coal mines, and recreation. Uinta County's 3,500-job gain comes from the Overthrust Belt, while Moffat County's additional 1,600 jobs will depend on both Aquatrain and coal developments. Projects discussed above will add slightly over 1,000 workers to Sweetwater County. In the later 1990s, recreation will expand Routt County's employment by about 1,500. Oil shale will add about 1,500 employees to Rio Blanco County and coal will add about 1,000 to Carbon County. Relatively few jobs are expected to be added to other parts of the region. Lincoln County is omitted because no employment impacts are projected there under any of the leasing alternatives.

Table 4-25 shows that gains in employment and income resulting from the new coal mines would be relatively modest. No significant increases would occur in Rio Blanco, Routt, Sweetwater, or Uinta counties under any leasing alternative (there would be no new mines in Lincoln County). Moderately significant increases of about 10 to 13 percent would occur at full mine operation (1995 and after) under the High alternative in Moffat County and under both the Moderate and High alternatives in Carbon County. The only instances in which gains would reach 20 percent would be in Moffat and Carbon counties under the Maximum alternative. Two related factors are responsible for keeping the growth rates in employment and income low. One is the growth generated by other developments that will cause a sizable expansion in local labor forces. The other factor is the slackening in growth rates in some counties, both already occurring or expected to occur, that will increase the labor pool available for new mine jobs. Of course, these countywide average growth rates would not occur uniformly in each community within the counties.

A total of between 700 and 7,500 new permanent jobs in mining and secondary businesses would be created in the region by the year 2000, depending on the alternative selected. From 400 to 2,900 new construction jobs would be provided, but these would be temporary employment of one to three years duration. Wage and salary incomes would rise also, exceeding the increase in employment by one to two percent because of the higher average wage rates paid in the construction and mining fields.

Conversion of the Signal Butte tract to an underground operation shortly after the year 2000 would

TABLE 4-25
EMPLOYMENT IMPACTS - MOFFAT COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	6,472	8,100	9,300	9,800	9,900
Construction	559	720	900	1,100	930
Mining	1,076	1,700	2,150	2,220	2,370
All other	4,837	5,680	6,250	6,480	6,600
Total labor income	\$99,971	\$129,000	\$153,000	\$163,000	\$164,000
Additions to baseline from:					
Low Alternative			60	90	90
Construction			30	0	0
Mining			10	50	50
All other			20	40	40
Labor income			\$1,000	\$2,000	\$2,000
Moderate Alternative			170	420	420
Construction			80	10	10
Mining			20	230	230
All other			70	180	180
Labor income			\$3,000	\$9,000	\$9,000
High Alternative			510	1,000	1,000
Construction			230	30	30
Mining			60	530	530
All other			220	440	440
Labor income			\$9,000	\$20,000	\$20,000
Maximum Alternative			1,070	1,930	1,930
Construction			490	60	60
Mining			120	1,010	1,010
All other			460	860	860
Labor income			\$20,000	\$38,000	\$38,000

NOTE: Dollar figures represent thousands of dollars.

TABLE 4-25
(Continued)

EMPLOYMENT IMPACTS - RIO BLANCO COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	4,788	5,300	8,400	10,500	9,900
Construction	1,097	1,030	2,300	2,820	1,650
Mining	1,563	1,790	2,350	3,080	3,830
All other	2,128	2,480	3,750	4,600	4,420
Total labor income	\$92,557	\$103,000	\$164,000	\$208,000	\$197,000
Additions to baseline from:					
Low Alternative					
			190	340	340
Construction			80	10	10
Mining			20	180	180
All other			90	150	150
Labor income			\$4,000	\$7,000	\$7,000
Moderate Alternative					
			360	610	610
Construction			150	20	20
Mining			40	320	320
All other			170	270	270
Labor income			\$8,000	\$13,000	\$13,000
High Alternative					
			380	650	650
Construction			160	20	20
Mining			40	340	340
All other			180	290	290
Labor income			\$8,000	\$14,000	\$14,000
Maximum Alternative					
			410	720	720
Construction			180	20	20
Mining			40	380	380
All other			190	320	320
Labor income			\$9,000	\$15,000	\$15,000

NOTE: Dollar figures represent thousands of dollars.

TABLE 4-25
(Continued)

EMPLOYMENT IMPACTS - ROUTT COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	7,610	9,900	11,800	12,300	13,100
Construction	1,060	1,260	1,410	1,490	1,570
Mining	608	970	1,230	1,180	1,180
All other	5,942	7,670	9,160	9,630	10,350
Total labor income	\$99,909	\$149,000	\$174,000	\$180,000	\$191,000
Additions to baseline from:					
Low Alternative					
Construction			20	20	20
Mining			10	0	0
All other			0	10	10
Labor income			10	10	10
Moderate Alternative					
Construction			30	40	40
Mining			20	0	0
All other			0	20	20
Labor income			10	20	20
High Alternative					
Construction			240	410	770
Mining			120	10	20
All other			20	220	390
Labor income			100	180	360
Maximum Alternative					
Construction			310	530	890
Mining			150	10	20
All other			30	290	460
Labor income			130	230	410
			\$6,000	\$11,000	\$18,000

NOTE: Dollar figures represent thousands of dollars.

TABLE 4-25
(Continued)

EMPLOYMENT IMPACTS - CARBON COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	12,627	12,100	12,400	12,600	13,400
Construction	909	840	860	880	990
Mining	3,066	2,240	2,540	2,730	3,800
All other	8,652	8,990	8,990	8,990	8,630
Total labor income	\$252,847	\$232,000	\$241,000	\$247,000	\$277,000
Additions to baseline from:					
Low Alternative					
Construction					
Mining					
All other					
Labor income					
Moderate Alternative					
		130	1,360	1,360	
Construction		80	0	0	
Mining		0	710	710	
All other		50	650	650	
Labor income		\$3,000	\$37,000	\$37,000	
High Alternative					
		463	1,647	1,647	
Construction		280	0	0	
Mining		0	860	860	
All other		183	787	787	
Labor income		\$11,000	\$44,000	\$44,000	
Maximum Alternative					
		670	2,590	2,590	
Construction		400	0	0	
Mining		0	1,350	1,350	
All other		270	1,240	1,240	
Labor income		\$16,000	\$70,000	\$70,000	

NOTE: Dollar figures represent thousands of dollars.

TABLE 4-25
(Continued)

EMPLOYMENT IMPACTS - SWEETWATER COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	22,432	23,200	23,600	23,700	24,100
Construction	2,898	3,670	2,910	2,900	2,900
Mining	7,127	6,940	7,370	7,440	7,620
All other	12,407	12,590	13,320	13,360	13,580
Total labor income	\$407,011	\$421,000	\$429,000	\$431,000	\$437,000
Additions to baseline from:					
Low Alternative					
			140	230	230
Construction			40	0	0
Mining			40	120	120
All other			60	110	110
Labor income			\$4,000	\$7,000	\$7,000
Moderate Alternative					
			140	230	230
Construction			40	0	0
Mining			40	120	120
All other			60	110	110
Labor income			\$4,000	\$7,000	\$7,000
High Alternative					
			390	820	1,380
Construction			200	0	0
Mining			40	430	720
All other			150	390	660
Labor income			\$11,000	\$24,000	\$40,000
Maximum Alternative					
			390	820	1,380
Construction			200	0	0
Mining			40	430	720
All other			150	390	660
Labor income			\$11,000	\$24,000	\$40,000

NOTE: Dollar figures represent thousands of dollars.

TABLE 4-25
(Continued)

EMPLOYMENT IMPACTS - UINTA COUNTY

	1980	1985	1992	1995	2000
No Action Alternative					
Total employment	5,794	10,800	9,500	9,700	9,300
Construction	470	1,190	540	550	530
Mining	1,137	2,880	2,660	2,710	2,610
All other	4,187	6,730	6,300	6,440	6,160
Total labor income	\$76,650	\$143,000	\$126,000	\$128,000	\$123,000
Additions to baseline from:					
Low Alternative					
Construction					
Mining					
All other					
Labor Income					
Moderate Alternative					
			70	150	150
Construction			40	0	0
Mining			0	80	80
All other			30	70	70
Labor Income			\$2,000	\$4,000	\$4,000
High Alternative					
			70	150	150
Construction			40	0	0
Mining			0	80	80
All other			30	70	70
Labor Income			\$2,000	\$4,000	\$4,000
Maximum Alternative					
			70	150	150
Construction			40	0	0
Mining			0	80	80
All other			30	70	70
Labor Income			\$2,000	\$4,000	\$4,000

NOTE: Dollar figures represent thousands of dollars.

ENVIRONMENTAL CONSEQUENCES

raise mining and other employment by about another 240 jobs, mostly in Moffat County. This increase would not add significantly to the effects already described.

Population

As table 4-26 shows, Meeker, Rangely, Kemmerer, Diamondville, and Evanston are expected to be the communities most affected by population growth or decline from No Action alternative developments. Meeker would be affected mainly by oil shale development, which will continue through 1995. The Bonanza power plant, oil and gas, and Utah oil shale developments will cause growth in Rangely and Dinosaur. Steamboat Springs can expect a continued expansion for its winter recreation industry. Coal mine developments will be responsible for increases in Hayden and Oak Creek. Craig's growth, depending partly on Aquatrain and partly on coal mine expansions and new developments, would occur mainly before 1992. Growth in Kemmerer, Diamondville, Evanston, Lyman, and Mountain View--mostly associated with oil and gas activity--should peak in the late 1980's or early 1990's and be followed by a decline and then a stable situation.

Which communities would grow as the result of the proposed new mine developments is difficult to predict because most of the tracts are located at some distance from towns. Gravity models (which compare population against commuting time), residence patterns at existing mines, and judgment were the methods used to allocate employment and population in this analysis.

Rawlins, Rock Springs, and Craig are expected to incur the largest growth in total numbers, as shown in table 4-26. However, proportional growth would be as great or greater in some of the small communities, particularly Maybell, Baggs-Dixon, and South Superior. Major population increases would occur under the Moderate alternative in Rawlins (36 percent); under the High alternative in Rawlins (43 percent) and South Superior (32 percent); and under the Maximum alternative in Rawlins (65 percent), Baggs-Dixon (35 percent), Maybell (34 percent), and South Superior (32 percent). More moderate growth rates would occur under various alternatives (maximum rate shown in parentheses) in Craig (21 percent), Dinosaur (19 percent), Oak Creek (19 percent), Rock Springs (16 percent), Hayden (14 percent), and Rangely (12 percent).

Conversion of the Signal Butte Tract to an underground operation would increase Craig's population by about 300 and populations in both Maybell and Hayden by about 20 each. The effects would have

no significance in Craig and Hayden but would aggravate the already large growth in Maybell under the Maximum alternative.

The significance of population growth depends on its effects on each community's social characteristics and municipal finances and, therefore, is covered under those subjects.

Housing

Requirements for new housing parallel population growth, and the communities listed at the beginning of the Population section will experience the greatest increases in housing demand under the No Action alternative. Surplus housing presently existing in some of the communities would take up part, but not all, of the demand.

Table 4-27 shows that requirements for additional housing would be significant in those communities where a high proportionate growth would occur--Craig, Meeker, Rangely, Maybell, Hayden, Oak Creek, Baggs-Dixon, and South Superior. In all of these communities housing shortages would appear, housing costs would rise, and financing might be more difficult to obtain. Too little data has been obtained on present housing supply, costs, and the resources of local financial institutions to permit numerical estimates of these effects. However, they would be more severe and lasting than those of some other recent developments because the majority of the demand would be for permanent, rather than temporary or mobile, housing. The present vacancies in most communities would not suffice to meet the expected demand and would, in fact, probably be absorbed by the growth expected to occur without new Federal coal development.

Conversion of the Signal Butte Tract would increase new housing requirements by an additional 110 in Craig and by about 10 each in Maybell and Hayden. The significance of these effects would parallel those of population.

Affected Industries

The earnings losses of individual ranch operations and the large increase in coal production that would be caused by new Federal coal development are described below. No other industries would be significantly affected. Decreased hunting opportunities that would result from losses of animal populations would reduce spending by hunters a maximum of one percent in any county.

TABLE 4-26

POPULATION IMPACTS

	1980	1992	1995	2000	1980	1992	1995	2000
Craig					Dinosaur			
No Action Alternative	10,239	13,410	13,990	13,990	312	610	640	660
Additions from:								
Low Alternative		0	0	0		30	120	120
Moderate Alternative		100	480	480		30	120	120
High Alternative		590	1,400	1,400		30	120	120
Maximum Alternative		1,480	2,950	2,950		30	120	120
Maybell					Meeker			
No Action Alternative	240	280	290	300	2,369	6,330	8,570	7,440
Additions from:								
Low Alternative		0	0	0		30	40	40
Moderate Alternative		10	20	20		280	470	470
High Alternative		20	50	50		310	530	530
Maximum Alternative		50	100	100		360	640	640
Rangeley					Hayden			
No Action Alternative	2,126	3,820	4,650	4,590	1,647	2,770	2,820	2,950
Additions from:								
Low Alternative		270	540	540		10	10	10
Moderate Alternative		270	540	540		20	30	30
High Alternative		270	540	540		140	200	260
Maximum Alternative		270	540	540		230	330	400
Milner					Oak Creek			
No Action Alternative	150	200	200	200	890	1,390	1,410	1,440
Additions from:								
Low Alternative		0	0	0		5	5	5
Moderate Alternative		0	0	0		5	5	5
High Alternative		1	2	4		30	80	260
Maximum Alternative		2	2	4		40	90	270

TABLE 4-26
(Continued)

POPULATION IMPACTS

	1980	1992	1995	2000	1980	1992	1995	2000
	Phippsburg				Steamboat Springs			
No Action Alternative	200	210	210	210	6,480	9,320	9,690	10,580
Additions from:								
Low Alternative		0	0	0		30	20	20
Moderate Alternative		0	0	0		30	20	20
High Alternative		0	0	3		280	470	820
Maximum Alternative		0	0	3		320	540	890
	Yampa				Baggs - Dixon			
No Action Alternative	450	550	560	560	515	500	510	540
Additions from:								
Low Alternative		0	0	0		0	0	0
Moderate Alternative		0	0	0		0	0	0
High Alternative		0	5	20		0	0	0
Maximum Alternative		0	5	20		30	180	180
	Rawlins				Other Carbon County			
No Action Alternative	11,547	10,860	11,130	12,570	9,834	10,140	10,160	10,190
Additions from:								
Low Alternative		0	0	0		0	0	0
Moderate Alternative		320	3,990	3,990		5	90	90
High Alternative		1,120	4,840	4,840		5	90	90
Maximum Alternative		1,540	7,210	7,210		55	370	370
	Diamondville				Kemmerer			
No Action Alternative	1,000	1,970	2,150	2,220	3,273	6,170	6,760	7,020
Additions from:								
Low Alternative		0	0	0		0	0	0
Moderate Alternative		10	20	20		15	50	50
High Alternative		10	20	20		15	50	50
Maximum Alternative		10	20	20		15	50	50

TABLE 4-26
(Continued)

POPULATION IMPACTS

	1980	1992	1995	2000	1980	1992	1995	2000
	Green River				Point of Rocks			
No Action Alternative	12,807	13,480	13,560	13,740	210	210	210	210
Additions from:								
Low Alternative		40	70	70		5	10	10
Moderate Alternative		40	70	70		5	10	10
High Alternative		120	320	530		5	10	10
Maximum Alternative		120	320	530		5	10	10
	Rock Springs				South Superior			
No Action Alternative	19,454	21,400	21,520	21,760	586	610	620	620
Additions from:								
Low Alternative		310	550	550		30	50	50
Moderate Alternative		310	550	550		30	50	50
High Alternative		780	2,000	3,390		50	120	200
Maximum Alternative		780	2,000	3,390		50	120	200
	Evanston				Lyman			
No Action Alternative	6,421	10,620	10,800	10,400	2,284	3,110	3,160	3,050
Additions from:								
Low Alternative		0	0	0		0	0	0
Moderate Alternative		110	320	320		15	50	50
High Alternative		110	320	320		15	50	50
Maximum Alternative		110	320	320		15	50	50
	Mountain View							
No action Alternative	628	860	870	840				
Additions from:								
Low Alternative		0	0	0				
Moderate Alternative		10	20	20				
High Alternative		10	20	20				
Maximum Alternative		10	20	20				

TABLE 4-27
NEW HOUSING REQUIREMENTS

	1992	1995	2000	1992	1995	2000
	Craig			Dinosaur		
No Action Alternative	700	900	900	0	0	0
Additions from:						
Low Alternative	0	0	0	10	40	40
Moderate Alternative	40	170	170	10	40	40
High Alternative	210	500	500	10	40	40
Maximum Alternative	530	1,050	1,050	10	40	40
	Maybell			Meeker		
No Action Alternative	7	10	15	1,320	2,120	1,720
Additions from:						
Low Alternative	0	0	0	10	15	15
Moderate Alternative	4	7	7	100	170	170
High Alternative	7	18	18	110	190	190
Maximum Alternative	18	35	35	130	230	230
	Rangely			Hayden		
No Action Alternative	150	440	420	190	200	250
Additions from:						
Low Alternative	100	190	190	4	4	4
Moderate Alternative	100	190	190	7	10	10
High Alternative	100	190	190	50	70	90
Maximum Alternative	100	190	190	80	120	140
	Milner			Oak Creek		
No Action Alternative	0	0	0	0	0	0
Additions from:						
Low Alternative	0	0	0	0	0	2
Moderate Alternative	0	0	0	0	0	2
High Alternative	1	1	2	0	18	90
Maximum Alternative	1	1	2	0	21	100

TABLE 4-27
(Continued)

NEW HOUSING REQUIREMENTS

	1992	1995	2000	1992	1995	2000
	Phippsburg			Steamboat Springs		
No Action Alternative	0	0	0	520	660	980
Additions from:						
Low Alternative	0	0	0	10	7	7
Moderate Alternative	0	0	0	10	7	7
High Alternative	0	0	1	100	170	290
Maximum Alternative	0	0	1	110	190	320
	Yampa			Baggs - Dixon		
No Action Alternative	0	0	0	0	4	15
Additions from:						
Low Alternative	0	0	0	0	0	0
Moderate Alternative	0	0	0	0	0	0
High Alternative	0	0	0	0	0	0
Maximum Alternative	0	0	0	12	50	50
	Rawlins			Other Carbon County		
No Action Alternative	0	0	370	90	95	105
Additions from:						
Low Alternative	0	0	0	0	0	0
Moderate Alternative	0	1,020	1,170	2	30	30
High Alternative	160	1,270	1,420	2	30	30
Maximum Alternative	320	1,960	2,120	20	110	110
	Diamondville			Kemmerer		
No Action Alternative	220	290	310	700	930	1,040
Additions from:						
Low Alternative	0	0	0	0	0	0
Moderate Alternative	3	6	6	6	13	13
High Alternative	3	6	6	6	13	13
Maximum Alternative	3	6	6	6	13	13

TABLE 4-27
(Continued)

NEW HOUSING REQUIREMENTS

	1992	1995	2000	1992	1995	2000
	Green River			Point of Rocks		
No Action Alternative	260	290	350	7	7	7
Addition from:						
Low Alternative	13	20	20	3	5	5
Moderate Alternative	13	20	20	3	5	5
High Alternative	30	100	160	3	5	5
Maximum Alternative	30	100	160	3	5	5
	Rock Springs			South Superior		
No Action Alternative	840	880	970	15	15	15
Additions from:						
Low Alternative	100	160	160	10	15	15
Moderate Alternative	100	160	160	10	15	15
High Alternative	270	580	990	17	35	60
Maximum Alternative	270	580	990	17	35	60
	Evanston			Lyman		
No Action Alternative	0	0	0	0	0	0
Additions from:						
Low Alternative	0	0	0	0	0	0
Moderate Alternative	40	90	90	6	13	13
High Alternative	40	90	90	6	13	13
Maximum Alternative	40	90	90	6	13	13
	Mountain View					
No Action Alternative	0	0	0			
Additions from:						
Low Alternative	0	0	0			
Moderate Alternative	3	6	6			
High Alternative	3	6	6			
Maximum Alternative	3	6	6			

NOTE: Figures are the projected number of new households since 1983.

ENVIRONMENTAL CONSEQUENCES

Agriculture

Four individual ranch operations would incur significant losses of earnings with a change of land use from grazing to coal development (see Land Use). Under both the High and Maximum alternatives, the Salt Wells Livestock Company would lose about \$15,000 per year through leasing of the Pio tract (in combination with the Bean Springs PRLA). Under the Maximum alternative, leasing of the Williams Fork tract would cause annual losses of about \$5,000 to Jake Hamill and \$20,000 to Frank Self. In addition, combined leasing of the Horse Gulch, Lay Creek, Signal Butte, and Williams Fork tracts under the Maximum alternative would cause annual losses of about \$55,000 to Gerald Culverwell. The proportionate loss to Frank Self would be highly significant; proportionate losses to the other three operations would be of moderate significance. Conversion of the Signal Butte Tract would not change these losses because they would be caused by the initial surface mining.

On a countywide basis, all effects of new coal development on agriculture would be insignificant. Combined reductions in agricultural earnings from losses of grazing land and conversion of irrigation water and cropland to industrial and urban uses would total no more than one percent in any county.

Local Government Finances

Bonding capacity and requirements are explained in more detail and specific numbers are given in Appendix 3. Appendix 3 also presents a discussion of how services needed by the community (water, sewer, hospitals etc.) have been assigned a dollar value and translated into improvements requirements. The discussion of bonding capacity as compared to investment requirements can be construed in a very broad sense to evaluate quality of life for a community in terms of facilities and services provided.

In the analysis here and the detailed analysis presented in Appendix 3, priority is given to capital funding because the costs of facilities improvements are usually the most difficult to meet using local resources. However, the capital analysis is limited to communities and school districts because insufficient data has been obtained on special districts and on those factors other than population growth which determine county facilities needs. An analysis of annual operating revenues and expenditures is not included for the same reason. However, the direct revenue contributions by the mines to the various jurisdictions is provided.

Financial stresses are likely to accompany population growth under the No Action alternative in Craig, Meeker, and Kemmerer--communities that either have little excess capacity in their present facilities or have committed a large part of their financial resources to current expansion programs. Those communities, and others to a smaller extent, would have potential capital improvements requirements in excess of their projected capacities to incur additional debt. Problems of an opposite nature may appear later, especially in the Uinta County communities, as shrinking oil and gas activity leaves unused capacity and unpaid debts in the hands of a smaller population.

Under the leasing alternatives, counties, communities, school districts, and other local jurisdictions in the vicinity of the new mines would benefit from increased revenues, both from taxes paid by the mines and from taxes and other revenues resulting from induced population and business growth. However, many of these jurisdictions would face sharply increased capital and operating costs to maintain their facilities and services at adequate levels. Costs would outweigh benefits for most of the communities.

Revenue and cost impacts frequently occur in different locations, giving rise to the problem of mismatches. These most often result from mining impacts such as the new Federal coal development. The tracts are in rural areas, and revenues from the new mines would go to counties. However, population growth would occur in the communities, which would bear the brunt of the costs. Therefore, in the absence of any equalizing mechanism, some jurisdictions (mostly counties) would gain, while others (mostly communities) would lose.

Payments of property and severance taxes and Federal royalties by the mines would be sizable, as can be seen in table 4-28. They would range from about \$5 million annually under the Low alternative to over \$100 million under the Maximum alternative. Between 70 and 75 percent of these revenues would be retained by the Federal and state governments, but significant amounts would go to the counties and communities. Carbon County, in particular, would receive amounts practically equalling its revenues from all other sources under the Moderate, High, and Maximum alternatives. Significant increases would also be realized by Moffat County under the the same three alternatives, by Rio Blanco County under all leasing alternatives, and by Routt and Sweetwater counties under the High and Maximum alternatives. Of the Colorado communities, only Craig would receive major benefits, and only under the Maximum alternative. Although the exact amounts going to Wyoming communities cannot be estimated, it is likely that Rawlins, at

TABLE 4-28

DIRECT MINE TAXES
(Thousand dollars)

	Low Alternative	Moderate Alternative	High Alternative	Maximum Alternative
Revenues				
Property taxes	\$ 628	\$18,846	\$21,597	\$25,146
Severance Taxes	1,647	27,402	33,763	41,529
Federal royalties	2,623	15,982	24,946	37,615
Distribution				
United States	1,312	7,991	12,473	18,807
Colorado	1,158	4,963	9,977	17,005
Wyoming	1,188	27,423	31,585	36,798
Moffat County	0	1,025	2,153	3,462
Rio Blanco County	454	858	858	858
Routt County	56	56	624	1,050
Carbon County	0	17,745	17,745	20,839
Sweetwater County	548	548	2,869	2,869
Uinta County	0	311	311	311
Craig	0	66	161	301
Dinosaur	0	6	14	26
Meeker	20	38	38	38
Rangely	20	38	38	38
Hayden	1	1	6	9
Oak Creek	0	0	3	5
Steamboat Springs	3	3	28	43
Yampa	0	0	1	2
Wyoming: All local governments	100	839	1,030	1,325
Communities	38	319	392	504

NOTES: Maybell, Milner, and Phippsburg are unincorporated and would not be included in distributions.

Wyoming distribution formulas are too complex to permit estimates of distributions to individual communities.

ENVIRONMENTAL CONSEQUENCES

least, would obtain a generous increase under all but the Low alternative. Additionally, part of the funds accruing to state governments would become available to the affected areas through impact grants. However, as stated earlier, these tax benefits would fall short of the added costs resulting from population growth in most communities.

Impacts to the communities would be expressed in the lack of services. Services which could be lacking include educational, medical, water and sewer, park, and recreation facilities, among other items. These have been assigned a dollar value as described in Appendix 3.

Potential shortfalls in facilities could vary, depending on what services the communities decided to provide and which they decided were not needed as badly.

Due to this uncertainty, the system outlined in Appendix 3 has identified the total value of facilities needed (in terms of bonding requirements) and the ability of communities to provide these services for themselves (in terms of bonding capacity). Current allocation systems for each of the states for dispersal of their 50 percent share of the Federal revenues from coal leasing have been considered in the analysis. The shortfalls identified in bonding capacity could be lessened by any one of the potential mitigation measures discussed later in this section.

The capital funding analysis in Appendix 3 compares the (1) estimated costs of community and school district capital improvements that would be required to serve the increased population and business activity with (2) additions to the legal ability of the jurisdictions to issue general obligation bonds. Its purpose is to show how much of the expected capital costs could be met from local funding sources. Local bonding capacity has been used because it shows the ability of the community to take care of itself. Impact funds or other special sources of capital may or may not be available to the communities when needed. The requirements for capital improvements are rough estimates only, but they highlight those jurisdictions that could be expected to have fiscal problems if these developments occur.

Capital costs can be significant in two ways: their percentage relationship to the additional bonding capacity and their effects on already existing imbalances between capital needs and the ability to finance them. High percentage relationships show that the costs of growth would greatly exceed the increase in the ability to pay for it. This would occur in many of the jurisdictions. However, these percentage effects are most significant when a deficit already exists between bonding capacity and capital requirements, and those cases can be identified

by comparing figures for the No Action alternative. Craig, Meeker, Hayden, Oak Creek, and South Superior are the communities that may have difficulty in financing their needs through additional bonding, either because they would need major facilities expansions or because recent projects have already consumed their bonding capacity. Therefore, it is these communities that would be the most adversely affected financially by the proposed leasing. Conversion of the Signal Butte Tract would increase these effects but would not change their level of significance.

Other Economic Effects

The following effects would occur with new Federal coal development. However, the large number of factors influencing them makes a quantitative analysis impossible.

Like any major development, new Federal leasing would have both positive and negative effects on local business communities. Both increased population and local purchasing by the mines would add to the volume of business. However, this added volume would likely induce the development of new shopping centers and the entrance of new branches of national retail chains, providing increased competition to local merchants. Local consumers would benefit from the added competition and a greater variety of available shopping. Businesses would suffer from increased wage competition as high paying construction and mine jobs drew some employees from local stores and raised general wage levels.

New coal development would be likely to cause or worsen local inflation in those communities experiencing rapid population growth. Lack of local price data prevents quantification of those effects. They are usually most acute in the area of housing, and they most severely affect those groups in the population having low or fixed incomes.

Increased coal development would aggravate the region's already heavy dependence on the energy minerals industry. Such an occurrence is probably inevitable, given the existing resource base and small population. In those areas that are already highly dependent on the coal industry, it would have a stabilizing effect. However, in other parts of the region it can obviously lead to future problems. At the end of the mine lives the region's economy would shrink, with resulting losses of employment and population, unless other developments occurred that would take the place of these mines. Developments that far in the future are impossible to predict now; in any event, it is unlikely that they

ENVIRONMENTAL CONSEQUENCES

could completely replace an economic element as large as coal development. Further planning for public and private developments should take into account the inherent economic instability that dependence on a single industry creates and the difficulty of replacing such a large economic base with other activities.

Unavoidable Adverse Effects

All adverse effects described in this analysis must be considered unavoidable because there are no mitigation measures that would be automatically enforced. Some of the effects probably would be mitigated, but where and to what extent cannot be estimated. Under the Low alternative the significant adverse effects would include increased housing needs at Rangely (in combination with baseline demands). Under the Moderate alternative, significant adverse effects would include financial strains at Meeker and Craig, and housing needs at Meeker and Rangely (in combination with baseline). Under the High alternative, they would include population growth and housing needs at South Superior, Rangely, Meeker, Craig, Hayden, Maybell, and Oak Creek; financial effects at Meeker, South Superior, Craig, Hayden, and Oak Creek; and losses to one ranch operation. The Maximum alternative would cause significant population growth and housing needs at Rangely, Meeker, Maybell, Baggs-Dixon, South Superior, Craig, Hayden, and Oak Creek; financial effects at Meeker, Craig, Hayden, Oak Creek, and South Superior; and losses to two ranch operations.

Short-Term Use vs. Long-Term Productivity

The highly significant losses to one ranching operator under the Maximum alternative might be long term if they forced him out of business. All of the other effects described in Unavoidable Adverse Effects would be short term because they would be the adjustments in facilities and services required for larger populations (except for losses to the other three individual ranchers, which would last for the lives of the mines). In addition, there would be significant beneficial effects, all of which would exist only during the lifetimes of the mines. Under all alternatives these would include beneficial financial effects from population growth in Dinosaur and Rangely. Under the Low alternative they would also include increased coal production and tax revenues in Rio Blanco County. Under the Moderate alternative they would include employment and income

growth in Carbon County and increased coal production and tax revenues in Carbon and Rio Blanco counties. Under the High and Maximum alternatives, they would include employment growth in Carbon and Moffat counties and increased coal production and tax revenues in Moffat, Rio Blanco, Routt, Carbon, and Sweetwater counties.

In the long term, productivity in the region would be increased through infrastructure improvements and growth and diversification of local business. However, losses in economic activity resulting from eventual termination of the mines, unless replaced by other economic growth, would make that productivity of no further value after the mines close.

Irreversible or Irretrievable Commitments of Resources

None of the significant economic effects would be irreversible or irretrievable.

Potential Mitigation

Federal contributions to the mitigation of economic effects brought about by Federal leasing and land ownership take the form of monies returned to the state and local governments. Specific spending and distribution decisions are properly left to the state, county, and community levels. The Federal government returns 50 percent of all royalties, bonuses, and other mineral revenues to the state. In Colorado, the state redistributes 50 percent of these funds to the affected local areas (up to an annual limit of \$800,000 per county). In Wyoming, about 30 percent of the funds are redistributed, mostly through special purpose capital construction programs. Distribution of a larger proportion of these funds to communities could help mitigate impacts. Local governments also receive funds as Payment in Lieu of Taxes in counties containing large proportions of Federal lands.

Severance taxes imposed by the states are also used for economic and social mitigation. In addition, towns and counties have authority to impose zoning and to negotiate tax prepayment and other arrangements with industries for these purposes.

Preparation for economic impacts requires lead time. Local governments, highway departments, etc. should be informed of new plans and changes in plans by companies and Federal agencies far enough in advance to allow construction of additional facilities ahead of the demand (or cancellation of preparations before they are irretrievably

ENVIRONMENTAL CONSEQUENCES

committed). Likewise, timing of Federal actions so that they do not occur simultaneously with other large private or public developments would keep local growth-related problems from becoming excessive.

SOCIAL IMPACTS

Social change by its very nature is a constantly occurring, complex process which affects persons differently, depending upon their places in the existing social structure; their individual characteristics, attitudes, and preferences; and the type and rate of change taking place. Some persons, or categories of persons, will gain. Others will lose, and still others may be untouched by particular social changes.

This winner-loser situation means that BLM decisions will play favorites among various affected groups, for some will suffer irretrievable losses: teenagers who get into trouble because of family tensions caused by crowding in unsatisfactory housing, small storekeepers wiped out by an incoming chain store, elderly folk living in rental apartments whose rent rises beyond their means, women trapped in the loneliness of transiency, ranchers whose traditional social power is lost, and others. Such losses are offset by gains for others more fortunately placed.

Precisely who, or how many, will be losers is unknown relative to each alternative, but such losses are unavoidable. Decisionmakers must therefore be aware of these human costs and seek to minimize them where possible, understanding that any decision will inevitably favor some persons and groups over others. Any decisions made thus involve moral considerations as well as purely objective factors.

Annual population growth rate is the best available single indicator of degree of social impacts of energy development upon communities. It is assumed that annual growth or decline of less than 1 percent produces no social impacts; it therefore is not shown. Growth rates between 1 and 4 percent are ranked as producing low impacts; between 4.1 and 8 percent, moderate impacts; between 8.1 and 13 percent, high impacts; and more than 13 percent, severe impacts. These categories are an effort to bracket the judgments of social researchers, whose estimates of severe social impact occur in a range from 5 to 15 percent annual growth.

Such rates, of course, are only a rough surrogate for actual social impacts. They are subject to errors to the extent that the baseline population projections turn out to be incorrect. Also, as discussed in

Chapter 3, a number of possible modifying factors exist for any given community.

Table 4-29 portrays annual growth rate estimates for each community of the study area under the No Action alternative. This table indicates that Craig, Dinosaur, Meeker, and Rangely in Colorado are expected to continue growing at variously significant rates through 1995. For those years in which the table shows low impacts for these four communities, the principal effects would be a greater diversification of social power, an increase in outside social and economic linkages, and changes toward more formalization of social processes. A gradual shift would occur toward more secondary interactions in many services and other aspects of social relationships.

Assuming Aquatrain construction, Craig is expected to have moderate social impacts between 1985 and 1990 from baseline growth alone, and a decline to low impacts in 1990-92. Dinosaur is projected to have moderate impacts until 1985, but its greatest baseline growth should occur in 1990-92 due to expected oil shale activity nearby in Utah. The present positive attitudes toward growth will probably continue in Dinosaur throughout the study period.

Rangely's baseline social impacts are expected to be moderate over the entire period to 1995. Because of its persistent, moderately large growth, Rangely's impacts would occur at a more rapid rate and produce additional conflicts, especially between stable residents and transient workers.

Assuming resumption of Piceance Basin oil shale activity, Meeker will overcome its present slump and experience baseline impacts of high to severe significance through 1995. Its longer-term high to severe social impacts would be mostly in the form of family discomforts and stresses from housing, facilities, and services shortages, along with increased traffic congestion and other factors. Additionally, there is potential for considerable conflict within the community between those favoring and/or profiting from growth and those resisting such growth. As in Rangely, transient workers, in particular, are not well integrated (or welcomed). Women and teen-age youth would also be subject to negative social integration problems.

Routt County communities, except for Steamboat Springs (with its growing ski industry) and Oak Creek, are not expected to continue significant baseline growth during the study period.

In Wyoming, Carbon and Sweetwater County communities will in general show small proportionate population growth through 2000. The communities located in the Overthrust Belt of Wyoming (Kemmerer-Diamondville, Lyman-Mountain View,

TABLE 4-29
BASELINE GROWTH (NO ACTION ALTERNATIVE)

	Population 1980	Population 1985	Percent Annual Growth Rate 1980 - 1985		Population 1990	Percent Annual Growth Rate 1985 - 1990		Population 1992	Percent Annual Growth Rate 1990 - 1992		Population 1995	Percent Annual Growth Rate 1992 - 1995		Population 2000	Percent Annual Growth Rate 1995 - 2000	
			Percent	Impact		Percent	Impact		Percent	Impact		Percent	Impact		Percent	Impact
COLORADO																
Moffat County																
Craig	10,239	11,220	1.8	L	13,780	4.2	M	13,410	1.3	L	13,990	1.4	L	13,990	--	--
Maybell	240	230	--	--	280	4.0	L	280	--	--	290	1.2	L	300	3.4	L
Dinosaur	312	420	6.1	M	490	3.1	L	610	11.6	H	640	1.6	L	660	3.1	L
Rio Blanco County																
Rangely	2,126	2,730	5.1	M	3,360	4.2	M	3,820	6.6	M	4,650	6.8	M	4,590	--	--
Meeker	2,369	2,650	2.3	L	4,960	13.4	S	6,330	13.0	H	8,570	10.6	H	7,440	-2.8	L
Routt County																
Steamboat Springs	6,480	7,990	4.3	M	9,090	2.6	L	9,320	1.2	L	9,690	1.3	L	10,580	1.8	L
Hayden	1,647	2,220	6.2	M	2,770	4.5	M	2,770	--	--	2,820	--	--	2,950	--	--
Oak Creek	890	1,200	6.2	M	1,370	2.7	L	1,390	1.5	L	1,410	--	--	1,440	--	--
Yampa	450	540	3.7	L	550	--	--	550	--	--	560	--	--	560	--	--
Phippsburg	200	190	-1.0	L	210	2.0	L	210	--	--	210	--	--	210	--	--
Milner	150	190	4.8	M	200	1.0	L	200	--	--	200	--	--	200	--	--
WYOMING																
Carbon County																
Rawlins	11,547	10,430	-1.9	L	10,740	--	--	10,860	--	--	11,130	--	--	12,570	2.5	L
Baggs	515	490	--	--	500	--	--	500	--	--	510	--	--	540	1.1	L
Sweetwater County																
Point of Rocks	210	210	--	--	210	--	--	210	--	--	210	--	--	210	--	--
South Superior	586	580	--	--	610	1.0	L	610	--	--	620	--	--	620	--	--
Rock Springs	19,454	20,620	1.2	L	21,470	--	--	21,400	--	--	21,520	--	--	21,760	--	--
Green River	12,807	13,410	--	--	13,570	--	--	13,480	--	--	13,560	--	--	13,740	--	--
Uinta County																
Kemmerer-Diamondville	4,273	7,940	13.2	S	7,260	-1.7	L	8,140	5.9	M	8,910	3.1	L	9,240	--	--
Lincoln County																
Evanston	6,421	11,650	12.7	H	10,220	-2.5	L	10,620	2.0	L	10,800	--	--	10,400	--	--
Lyman-Mountain View	2,912	4,240	7.8	M	3,890	-1.7	L	3,970	1.0	L	4,030	--	--	3,890	--	--

- = Less than 1% (no impacts)

L = Low impacts (1 - 4%)

M = Moderate impacts (4.1 - 8%)

H = High impacts (8.1 - 13%)--significant

S = Severe impacts (over 13%)--significant

ENVIRONMENTAL CONSEQUENCES

and Evanston) will probably grow at a rapid rate until 1985. After a slump between 1985 and 1990, they are expected to continue to have social impacts from low to moderate growth until 1992 because of oil and gas development in the Overthrust Belt. After 1992 these communities are expected to remain stable with respect to baseline growth.

Social impacts for these Overthrust Belt towns will consist of a continuation of the processes of formalization, deterioration (later catching up) of physical facilities, community services lag, etc. Some of the potential social mitigations suggested at the end of this section could modify the worst levels of these problems for these towns (as well as for Meeker), assuming prompt action, especially with respect to the human costs for transients, women, and youth.

Because of recent (and current in some cases) boom conditions, all of the study communities are better prepared for social changes than, for instance, Rock Springs and Craig were in 1970. Formalization of controls and services, installation in many instances of more adequate physical facilities, and diversification of power and local governmental representation have occurred in the larger towns and have progressed according to size and recent impacts for the smaller towns. Citizens generally have become more accepting of, and often positive toward, additional growth. Attitudes toward cultural differences are less resistant than prior to 1970. It is likely that negative stereotyping of transient workers has also lessened, except in the Meeker and Rangely areas.

For all communities affected, social advantages would accrue to some of the local people, and the community would benefit from improved ability to respond to certain kinds of needs (mental health, for example) and a better variety of employment opportunities.

To summarize, several communities will experience substantial additional growth until the year 2000 from causes other than the proposed coal leasing actions. Social problems will probably be manageable, however, except for Meeker, Kemmerer-Diamondville, and Evanston. For these three, it is likely that social pressures will develop for temporary periods of time. Meeker will have sustained rapid growth for about 10 years, followed by a decline, and the decline, though small in population lost, may be felt more negatively because of the longer period of growth preceding the decline.

The four leasing alternatives would result in additional impacts. Tables 4-30 through 4-33 show which communities would be affected, in which years and to what degree, by the Low, Moderate, High, and Maximum alternatives.

The growth estimates are computed from predicted construction and mining employment, plus secondary employment generated by these, from the beginning of construction until full production is reached for the various tracts. The general patterns of these components were described in Chapter 3.

Since the leasing alternatives are cumulative, each higher alternative contains all the social impacts of all lower alternatives plus additional ones in the form of either greater impacts on some of the same communities, or impacts on additional communities, or both.

Two Colorado and two Wyoming communities would experience social impacts under the Low alternative. For Rangely and Dinosaur in Colorado, social impacts would be moderate to high for 1991 and 1993, with growth continuing more slowly in 1994, as shown by table 4-30. Currently, both have poor ability to absorb new growth because of facilities and housing shortages. However, both towns have accepted the idea of growth, and, except for some recent negativism toward transients in Rangely, social conflicts would be unlikely to develop.

South Superior, Wyoming, is an incorporated small town which struggled for existence in the years between the initiation of dieselized railroads (about 1950) and the start of the Jim Bridger plant and coal mine in the early 1970's. Although physical facilities and community services are limited, the local residents, like those of Rangely, have long been positive toward growth and are familiar with the life styles associated with energy development. Its small though steady growth from the Low alternative would not be likely to produce any serious social difficulties and in all likelihood would be welcomed.

Point of Rocks, Wyoming, an unincorporated trailer village on Highway I-80 at the turn-off to Bridger Plant road, has only one truck-stop type general store and cafe. The community grew to its present size with construction of the Bridger facility. Presently, this community has a low degree of social cohesion. Its largely male population orients to shopping and entertainment in Rock Springs. The lack of social amenities would mean that mostly transient trailer dwellers would choose that location, with few social effects other than some crowding of the trailer park itself. The few family groups, transient or not, would certainly seek each other out for sociability, with resulting formation of basically primary type groups in which persons would come and go but the groups would be maintained for periods of time. Such an informal system would fill some social needs, but a heavy reliance on Rock Springs for formal needs (e.g., church, social services, schools) would continue.

TABLE 4-30

ANNUAL COMMUNITY GROWTH--LOW ALTERNATIVE

Community	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level
Rangely	--	--	3,590 6.8 M		--	--	4,097 4.9 M		4,374 1.3 L		--	--	--	--	--	--	--	--	--	--	--	--
Dinosaur	--	--	550 4.9 M		--	--	620 10.6 H		630 3.0 L		--	--	--	--	--	--	--	--	--	--	--	--
South Superior	610 1.1 L		610 2.8 L		610 1.8 L		610 2.1 L		610 --		--	--	--	--	--	--	--	--	--	--	--	--
Point of Rocks	210 1.0 L		210 1.4 L		210 1.4 L		210 1.4 L		210 1.0 L		--	--	--	--	--	--	--	--	--	--	--	--

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

TABLE 4-31

ANNUAL COMMUNITY GROWTH--MODERATE ALTERNATIVE

Community	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level
Rangely	--	--	3,590 6.8 M		--	--	4,097 4.9 M		4,374 1.3 L		--	--	--	--	--	--	--	--	--	--	--	--
Dinosaur	--	--	550 4.9 M		--	--	620 10.6 H		630 3.0 L		--	--	--	--	--	--	--	--	--	--	--	--
South Superior	610 1.1 L		610 2.8 L		610 1.8 L		610 2.1 L		610 --		--	--	--	--	--	--	--	--	--	--	--	--
Point of Rocks	210 1.0 L		210 1.4 L		210 1.4 L		210 1.4 L		210 1.0 L		--	--	--	--	--	--	--	--	--	--	--	--
Craig	--	--	--	--	--	--	13,603 1.1 L		--	--	--	--	--	--	--	--	--	--	--	--	--	--
Maybell	--	--	280 2.9 L		--	--	283 2.8 L		--	--	--	--	--	--	--	--	--	--	--	--	--	--

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

ENVIRONMENTAL CONSEQUENCES

Six additional towns would be socially affected by the Moderate alternative, as shown in table 4-31. Except for Rawlins (and Meeker in 1991), none of these would suffer more than minor impacts, and these only for a year or two, all easily managed. Meeker's low moderate growth in 1991 would be more significant because of an expected high baseline growth for the several years surrounding 1991.

Rawlins would have moderate growth in 1991 and slower growth in 1992, but it would be highly significantly affected socially in 1993 by almost 21 percent growth; the growth rate would drop back to moderate in 1994. If this pattern were expected in advance, the town would likely do little more than plan for a temporary bulge in housing and services for that year. Social structures would be hard pressed to manage the overloads while maintaining a more orderly change to absorb the steady moderate growth, though again advance planning would help.

Rawlins is already an important regional center. Outside social and economic linkages and other processes of urbanization would continue. Secondary social relationships would continue to multiply. Small neighborhood primary groups would tend to augment some decline in other primary forms. Specific interest groups (such as hobby clubs and political action groups) would become more numerous and partially replace less formal and more generalized friendship patterns typical of smaller towns.

It should be noted that the High and Maximum alternatives would prove considerably more socially disruptive for Rawlins. The years 1991 and 1993, in particular, would strain social structures drastically, especially in view of the lesser but ongoing growth in prior years. Most of the influx would consist of families who would use social institutions such as churches and schools and would require single-family housing for periods of a year or more. Attitudes and values are already diversified, so conflicts in these would probably not be major. However, social services and formal social controls would be overloaded.

Remoteness from large cities, retention of social values and patterns from still-fresh frontier histories, and recent rapid energy related growth have caused modifications in the usual urbanization processes for Craig, Rawlins, Rock Springs, and the other small cities of the study area. The ethos remains one of self-sufficiency and individualism rather than of urban sophistication in the usual sense, with life styles in general conforming to the prevailing ethos. This pattern is unlikely to be changed much by the kinds of growth assumed for these alternatives, since most of the incoming workers would continue to be blue collar, with corresponding interests and behaviors.

Craig, Maybell, Evanston, and Mountain View would experience low growth under the Moderate alternative and would be well able to manage accompanying social changes.

Tables 4-32 and 4-33 indicate the communities predicted to be socially changed by the High and Maximum alternatives. Rawlins has already been discussed. Except for a temporary population slump of 6 percent between 1995 and 1996, South Superior would continue to grow moderately from 1990 through 2000 under the High or Maximum alternative. The greatest impact years would be 1991 and 1993. As already noted, South Superior is positive toward energy growth because of its history as a coal mining town and the decline it began overcoming only when Jim Bridger plant was constructed in the early seventies. Also, because of its location several miles off the main highway and its lack of many amenities, self-selection by newcomers would bring in primarily those persons who prefer such a quiet location. These factors would help to reduce the social pressures of even fairly rapid growth. A temporary social problem might be the sudden reversal of growth predicted for 1996. This slump would tend to break up the new informal networks just as the community was reaching a state of social reintegration, requiring a new set of social adjustments. As growth picked up the following year, the process of network formation would undergo further adjustment.

Maybell, an unincorporated small settlement 30 miles west of Craig, began planning for expansion about 1980-81 because of expectation that a power dam would be constructed at nearby Cross Mountain. The dam project did not materialize. The community is thus better prepared than its small size would imply, with an expanded sewer system, a water plan ready to implement when needed, and zoning plans in place.

The moderate to severe growth potential from the High and Maximum alternatives would nevertheless produce strains on the social system of Maybell, which at present is highly informal. For instance, the community operates an overnight tourist camp in the local playground and park beside Highway 40, a service that would have to be discontinued or modified with rapid growth. Integration of the surrounding ranching population into the local social life would also be negatively affected as new informal interactions within the immediate community occurred; the very informal social power and community decision making structure would be disrupted.

Maybell citizens generally favor some growth, with reservations regarding protection of their environment and the preservation of their small town atmosphere. The strong growth expected from the

TABLE 4-32

ANNUAL COMMUNITY GROWTH--HIGH ALTERNATIVE

Community	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level
Rangely	--	--	6.8	M	--	--	4.9	M	1.3	L	--	--	--	--	--	--	--	--	--	--	--	--
Dinosaur	--	--	4.9	M	--	--	10.6	H	3.0	L	--	--	--	--	--	--	--	--	--	--	--	--
South Superior	610	1.5	610	6.4	610	2.5	610	6.7	610	2.3	--	--	620	-6.0	620	2.6	620	2.7	620	2.7	620	2.7
Point of Rocks	210	1.0	210	1.4	210	1.4	210	1.4	210	1.0	--	--	--	--	--	--	--	--	--	--	--	--
Craig	--	--	13,595	3.9	--	--	13,603	3.4	13,796	1.6	--	--	--	--	--	--	--	--	--	--	--	--
Maybell	--	--	280	5.7	280	1.4	283	8.1	286	1.0	290	1.4	--	--	--	--	--	--	--	--	--	--
Meeker	--	--	5,645	5.0	--	--	7,076	2.3	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Evans ton	--	--	10,475	1.2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mountain View	--	--	850	1.1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rawlins	10,740	1.2	10,800	13.6	10,860	1.8	10,950	21.4	11,040	6.3	--	--	--	--	--	--	--	--	--	--	--	--

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

TABLE 4-32
(continued)

ANNUAL COMMUNITY GROWTH--HIGH ALTERNATIVE

Community	1990		1991		1992		1993		1994		1995		1996		1997		1998		1999		2000	
	Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level
Hayden	--	--	4.8	M	--	--	1.6	L	--	--	--	--	3.0	L	--	--	--	--	--	--	--	--
Milner	--	--	--	--	--	--	--	--	--	--	--	--	1.5	L	--	--	--	--	--	--	--	--
Oak Creek	--	--	2.0	L	--	--	2.5	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Phippsburg	--	--	--	--	--	--	--	--	--	--	--	--	1.9	L	--	--	--	--	--	--	--	--
Steamboat Springs	--	--	2.9	L	--	--	1.6	L	--	--	--	--	4.3	M	--	--	--	--	--	--	--	--
Yampa	--	--	--	--	--	--	--	--	--	--	--	--	3.9	L	-1.2	L	--	--	--	--	--	--
Green River	--	--	--	--	--	--	1.0	L	--	--	--	--	-0.8	--	--	--	--	--	--	--	--	--
Rock Springs	--	--	3.2	L	--	--	3.5	L	1.0	L	--	--	-2.9	L	1.3	L	1.3	L	1.3	L	1.3	L

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

TABLE 4-33

ANNUAL COMMUNITY GROWTH--MAXIMUM ALTERNATIVE

Community	1990 Baseline		1991 Baseline		1992 Baseline		1993 Baseline		1994 Baseline		1995 Baseline		1996 Baseline		1997 Baseline		1998 Baseline		1999 Baseline		2000 Baseline	
	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact	Percent	Impact
	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level	Growth	Level
Rangely	--	--	3,590 6.8	M	--	--	4,097 4.9	M	4,374 1.3	L	--	--	--	--	--	--	--	--	--	--	--	--
Dinosaur	--	--	550 4.9	M	--	--	620 10.6	H	630 3.0	L	--	--	--	--	--	--	--	--	--	--	--	--
South Superior	610 1.5	L	610 6.4	M	610 2.5	L	610 6.7	M	610 2.3	L	--	--	620 -6.0	M	620 2.6	L	620 2.7	L	620 2.7	L	620 2.7	L
Point of Rocks	210 1.0	L	210 1.4	L	210 1.4	L	210 1.4	L	210 1.0	L	--	--	--	--	--	--	--	--	--	--	--	--
Craig	--	--	13,595 9.9	H	13,410 1.0	L	13,603 7.1	M	13,796 2.6	L	13,990 1.1	L	--	--	--	--	--	--	--	--	--	--
Maybell	--	--	280 15.0	S	280 3.2	L	283 12.0	H	286 1.4	L	290 3.8	L	--	--	--	--	--	--	--	--	--	--
Meeker	--	--	5,645 5.8	M	--	--	7,076 2.9	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Evans ton	--	--	10,475 1.2	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Mountain View	--	--	850 1.1	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Rawlins	10,740 1.7	L	10,800 17.8	S	10,860 2.7	L	10,950 32.8	S	11,040 9.7	H	11,130 1.2	L	--	--	--	--	--	--	--	--	--	--

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

TABLE 4-33
(continued)
ANNUAL COMMUNITY GROWTH--MAXIMUM ALTERNATIVE

Community	1990 Baseline		1991 Baseline		1992 Baseline		1993 Baseline		1994 Baseline		1995 Baseline		1996 Baseline		1997 Baseline		1998 Baseline		1999 Baseline		2000 Baseline	
	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level	Percent Growth	Impact Level
Hayden	--	--	2,770 7.5	M	--	--	2,787 2.6	L	--	--	--	--	2,846 3.1	L	--	--	--	--	--	--	--	--
Milner	--	--	--	--	--	--	--	--	--	--	--	--	200 1.5	L	--	--	--	--	--	--	--	--
Oak Creek	--	--	1,380 2.7	L	--	--	1,397 2.5	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Philpsburg	--	--	--	--	--	--	--	--	--	--	--	--	210 1.9	L	--	--	--	--	--	--	--	--
Steamboat Springs	--	--	9,205 3.3	L	--	--	9,443 1.9	L	--	--	--	--	9,868 4.3	M	--	--	--	--	--	--	--	--
Yampa	--	--	--	--	--	--	--	--	--	--	--	--	560 3.9	L	560 -1.2	L	--	--	--	--	--	--
Green River	--	--	--	--	--	--	13,495 1.0	L	--	--	--	--	13,645 -.8	--	--	--	--	--	--	--	--	--
Rock Springs	--	--	21,375 3.2	L	--	--	21,425 3.5	L	21,440 1.0	L	--	--	21,650 -2.9	L	21,665 1.3	L	21,775 1.3	L	21,810 1.3	L	21,760 1.3	L
Baggs-Dixon	--	--	500 8.2	H	500 1.8	L	503 18.5	S	506 5.7	M	--	--	--	--	--	--	--	--	--	--	--	--
Rural Carbon County	--	--	--	--	--	--	10,147 2.0	L	--	--	--	--	--	--	--	--	--	--	--	--	--	--

-- = Less than 1% (no impacts)

L = Low Impacts (1 - 4%)

M = Moderate Impacts (4.1 - 8%)

H = High Impacts (8.1 - 13%)--significant

S = Severe Impacts (>13%)--significant

ENVIRONMENTAL CONSEQUENCES

High or Maximum alternatives would still leave Maybell a small place without most facilities and services but could result in incorporation, with its increased formalization of governance and social controls.

The High and Maximum alternatives would produce slow steady growth in Rock Springs over the entire decade of the nineties, with minor social impacts that the town would be entirely able to manage if private development space limits were not exceeded.

The Baggs-Dixon area from 1991 to 1994 would be very significantly affected by the Maximum alternative. While Baggs has had boom conditions from oil and gas development nearby, Dixon remains a quiet, very tiny ranching center with one or two retail establishments and no other services. Residential growth from Baggs eastward has no doubt changed some informal social interaction patterns in Dixon, but the social nature of the immediate community would change drastically with substantial population influx. The entire area around Dixon and Savery orients to Baggs both socially and economically (with Craig and Rawlins as major shopping sources), and these ties would continue as long as Baggs retained its shopping facilities and the children attended school in Baggs.

Kemmerer and Diamondville in Lincoln County and Lyman in Uinta County were examined for social impacts from the proposed leasing actions but no noticeable social impacts were predicted under any of the alternatives.

The rural population of the entire study area is relatively sparse. While the expanding total levels of energy development in the region are gradually affecting the social power, political views, and life styles of the ranching peoples, the actions proposed by these alternatives would have only minute direct social effects upon the group as a whole. In several instances, however, the precise locations of individual ranches relative to proposed coal tracts could have drastic consequences for these particular ranches. A particular problem exists regarding a long-time ranch near the Pio Tract. However, in some instances, the landowners would have preventive or negotiating power regarding the lease.

Analyses were done of the proportions of transient construction workers and of the respective proportions of construction, operations, and secondary workers expected for each community for each year for each alternative. None of these was found to be of social significance. Though some of the larger towns (such as Craig) would have substantial numbers of transient or temporary construction workers, the towns' existing sizes and past boomtown experience would make even these proportions a manageable factor. The needs of tran-

sients in energy towns continue to be poorly met, but this has not generally been defined as a problem by most communities--a situation that is changing only very gradually. Especially vulnerable are the wives and children of transient workers.

Unavoidable Adverse Effects

The Low Leasing alternative would produce highly significant social impacts to Dinosaur in 1993 only.

The Moderate Leasing alternative would affect Dinosaur as noted, plus having severely significant social impacts on Rawlins in 1993. Beginning with this alternative, Meeker would have social impacts which would not be significant in themselves but which would aggravate the significant social impacts under the No Action alternative in the years 1990 to 1995.

The High Leasing alternative would include social impacts as noted on Dinosaur and Meeker. Rawlins would be severely affected in 1991 and again in 1993, and highly significant social impacts would occur for Maybell in 1993.

The Maximum Leasing alternative would include all the social impacts noted for the other alternatives. In addition, Craig would have highly significant impacts in 1991; Maybell would be severely affected in 1991 and highly so in 1993. Rawlins would continue having highly significant social impacts in 1994. The Baggs-Dixon area would experience highly significant social impacts in 1991 which would reach a severe level in 1993.

Not all social impacts would be adverse, but during the boom years noted, the adverse would undoubtedly be greater than the beneficial.

Short-Term Use vs. Long-Term Productivity

Over the long run, most social change produces social structures and value systems that are different from, but not generally perceived as worse than, those replaced or modified. Most social values are derived from the familiar and the relatively stable, not from some absolute definition of right and wrong. Slow change usually occurs without serious consequences for the total group. Rapid change makes for a more difficult transition (causing short-term social disruptions and personal costs). Thus, for some periods of time, Craig, Dinosaur, Maybell, Rawlins, and Baggs-Dixon would experience social losses of some importance. In the

ENVIRONMENTAL CONSEQUENCES

long term, the differences would tend to become a familiar and relatively stable new social system that would be as comfortable as the old one was. Some individual losses would remain over the long term, however.

Irreversible or Irretrievable Commitments of Resources

The social benefits from development of the proposed coal tracts can only be enjoyed once. As these nonrenewable resources are used up, all future user benefits are irretrievably lost. Social change tends to be irreversible but can usually be accommodated over the long term.

Potential Mitigation

Local authorities, industries and businesses, local organizations, and interested citizens can take many actions to alleviate economic and social impacts, including tapping into funding sources such as those described in the first Green River-Hams Fork EIS (DOI, BLM, August 1980) and the Final Supplemental EIS for the Prototype Oil Shale Leasing Program (DOI, BLM, January, 1983). Efforts would be more effective if carried out cooperatively by all public and private interests involved.

Negative social impacts are sometimes very difficult to ameliorate and often require efforts other than money. Many are easier, however, than has often been thought. The following suggestions can be recommended, and communities can undoubtedly think of others:

1. Mine start-ups could be timed so as to permit staggering of labor needs. Construction workers could then remain more permanently in one spot and growth rates could be spread out to avoid severe peaks and slumps.
2. Trailer park housing, especially for single transients, could be provided near mine sites, including spaces for RVs. In addition, eating and recreational facilities would be needed, and some attention would have to be given to providing recreational facilities in nearby towns, especially for weekend use.
3. Social services agencies typically are among the most useful sources of mitigations but usually have low funding priority. Communities could call on these agencies for information and guidance in identifying and meeting services delivery needs, including outreach programs for the smaller communities. This would require a

much stronger commitment to funding of these less tangible but essential services. Human Resources Councils could be formed to coordinate social services activities (as has been done already in some communities).

4. Efforts could be made to identify and welcome new arrivals (for instance, through obtaining names from employers) and to get them involved in community activities. Transients, housewives, and youth particularly need ways to counter loneliness and feelings of isolation. Community Resources Handbooks have been assembled and distributed in some communities; social outreach programs could be instituted. Churches and clubs have many opportunities to encourage participation and otherwise to help transients and new residents feel at home.
5. Communities can make efforts to identify the social "losers" of energy-related growth and offer them assistance wherever possible.
6. The processes of social change generally are similar wherever they occur. Community leaders could study these processes and, understanding and anticipating them, could seek to direct changes so as to minimize adverse impacts and maximize social benefits.
7. Beautification projects, even under rapid growth conditions, can prevent aesthetic deterioration of the community, provide creative outlets for many persons, and in general help to sustain community pride.
8. Vacant lots and empty buildings can often be converted at low cost into neighborhood recreation centers for young and old. Community volunteer leaders for hobbies, sports, etc., could provide invaluable service here.
9. Educational institutions could offer off-hours use of some facilities, and at-cost self-enrichment courses could be organized.

TRANSPORTATION

Highways

There would be no significant effect on the transportation systems in the region under the No Action alternative except on U.S. 40. Tables 4-34 and 4-35 show that all of the affected highways have adequate capacity to meet projected demands to the year 2000 except for U.S. 40 between Craig and Steamboat Springs. U.S. 40, segments B and C

TABLE 4-34

CAPACITY UTILIZED FOR COLORADO ROAD SEGMENTS

Road Segment	No Action			High Production			Maximum Production		
	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized	Capacity Utilized
	1992	1995	2000	1992	1995	2000	1992	1995	2000
A	.30	.32	.34	.35	.40	.43	.43	.60	.62
B	.79	.86	.94	.81	.88	.97	.81	.89	.97
C	.89	.95	1.05	.90	.97	1.11	.90	.97	1.11
D	.49	.52	.56	.61	.78	.83	.63	.82	.86
E	.26	.27	.30	.31	.36	.39	.30	.39	.42
F	.48	.51	.50	.54	.61	.60	.55	.72	.71
G	.06	.06	.08	.14	.16	.17	.14	.20	.22
H	.48	.52	.59	.48	.52	.59	.50	.56	.63
I	.52	.55	.61	.54	.58	.69	.54	.58	.69
J	.41	.44	.49	.42	.46	.51	.42	.46	.51
K	.18	.19	.21	.19	.21	.23	.19	.21	.23
L	.55	.59	.64	.60	.71	.77	.60	.71	.77

NOTE: Capacity utilized during peak traffic hours was calculated using formulas presented in the Colorado Department of Highway's 1980 Traffic Volume Study. Capacity and design hourly volume were assumed to remain at 1980 figures.

TABLE 4-35

CAPACITY UTILIZED FOR WYOMING ROAD SEGMENTS

Road Segment†	No Action			High Production			Maximum Production		
	Capacity Utilized 1992	Capacity Utilized 1995	Capacity Utilized 2000	Capacity Utilized 1992	Capacity Utilized 1995	Capacity Utilized 2000	Capacity Utilized 1992	Capacity Utilized 1995	Capacity Utilized 2000
A	.29	.31	.35	.29	.32	.36	.29	.32	.36
B	.47	.50	.57	.47	.51	.58	.47	.51	.58
C	.28	.31	.35	.29	.32	.36	.29	.32	.36
D	.26	.29	.32	.28	.30	.35	.29	.31	.35
E	.25	.27	.31	.25	.31	.35	.25	.31	.35
F	.40	.43	.48	.43	.60	.64	.47	.79	.84
G	.22	.24	.27	.22	.24	.27	.24	.29	.32
H	.11	.12	.13	.15	.18	.19	.15	.18	.19
I	.45	.48	.54	.51	.63	.89	.51	.63	.89
J	.44	.47	.52	.45	.49	.54	.45	.49	.54

NOTE: Capacity and design hourly volume were assumed to remain at 1981 figures.

ENVIRONMENTAL CONSEQUENCES

(see map 3-6 in Chapter 3), is projected to reach or exceed capacity by 2000. Most of the other road segments in Wyoming and Colorado would be at less than 50 percent of capacity during peak traffic hours. There would be a 55 percent increase in traffic volumes and a 59 percent increase in accidents in Colorado between 1980 and 2000. The increase in Wyoming from 1981 to 2000 would be 69 percent for both traffic volume and accidents.

As a result of new Federal coal leasing under the four leasing alternatives, an increase in average daily traffic can be expected on most roads within the study region. Tables 4-34 and 4-35 indicate that all of the highway segments analyzed would show increases in average daily traffic under the High and Maximum alternatives. The average daily traffic figures in the table include the trended analysis under the No Action alternative plus the direct and indirect traffic associated with the proposed leasing. The Moderate and Low alternatives are not shown because increases in average daily traffic affecting highway capacity would be insignificant.

Mine employees would increase average daily traffic; it is assumed that an average of two persons per vehicle would be commuting to and from the mine each day. All other population increases would generate 0.8 trips per day, which includes all nonbasic travel generated. These average daily traffic figures were distributed over each road segment according to attraction factors such as regional shopping areas, recreation areas, etc.

The increases over the No Action alternative level of average daily traffic for Colorado under the Low, Moderate, High, and Maximum alternatives are 1, 9, 17, and 25 percent, respectively. The increases in average daily traffic for Wyoming for the Low, Moderate, High, and Maximum alternatives are 1, 6, 11, and 14 percent, respectively.

Under the High alternative, U.S. 40 (segments B and C) in Colorado would reach or exceed capacity. U.S. 40 capacity would be reached by the year 2000 with or without the proposed coal leasing; new coal development would simply add to the existing traffic congestion. Colorado highway 13/789 (Segment D) and U.S. 191 (Segment I) in Wyoming would experience minor congestion or periodic slowdowns during peak traffic hours as capacity was approached by the year 2000.

Impacts to Colorado road segments under the Maximum alternative would be as described for the High alternative. In Wyoming, Wyoming 71 (segment F) and U.S. 191 (segment I) would be affected by proposed leasing. Minor road congestion or periodic lowering of the service level would become apparent by the year 2000 without improvements. All other Wyoming highways would have enough excess capacity to accommodate the predicted in-

creases in traffic volume under all alternatives. None of the impacts to highway capacity is considered to be significant in either Colorado or Wyoming under any of the leasing alternatives.

Craig, Rawlins, and Rock Springs would experience significant increases in their internal traffic under the High and Maximum alternative. Table 4-36 lists these increases by alternative for the year 2000. Increases assume five trips per new household per day and do not include the baseline. With the increased traffic, these towns would experience significant traffic disruption (Maximum alternative only) unless local traffic plans were updated, e.g., the planned highway 13/789 bypass near Craig.

Employee traffic for the Wild Horse Draw and Corral Canyon tracts (Moderate through Maximum alternatives) would increase average daily traffic through Sinclair. Added to the recreation and other local traffic on Seminoe Road, average daily traffic would increase by approximately 800 to 1,000 by 1995, which is significant. The increased traffic volumes through this residential area would cause unacceptable noise and safety hazards. Relocation of the West Sinclair I-80 Interchange and rerouting traffic to the west and north of Sinclair would be required.

The Bell Rock Tract (Maximum alternative) would add significant traffic to a 1-mile segment of U.S. 40 and less than 1 mile of Colorado 13/789 in west Craig, including the junction and Moffat County road 30. Approximately 230 coal truck trips per day would be required to haul coal to the Craig loadout. Added to mine employee traffic, the average daily traffic would increase by a total of 480 in 1995 and 2000. Periodic traffic congestion and increased accidents would occur on these highways in west Craig, as well as increased noise along the coal haul route.

Large average daily traffic increases would occur on county roads, including Moffat County roads 17, 30, 33, and 47 and Routt County roads 27, 53, 59, and 61 in Colorado (Maximum alternative). Large increases in average daily traffic would also affect several Wyoming county roads, including Seminoe Road and 20-Mile Road in Carbon County and Sweetwater County roads 4-15, 4-18, and 4-76. No data is available to analyze these roads, and potential for significant impacts is unknown.

The impacts of increased average daily traffic are increased noise (see Noise section), air pollution (see Air Quality section), animal road kills (see Wildlife section), traffic accidents, at-grade hazard ratings, road congestion, and maintenance costs.

Increases in the number of accidents are given in tables 4-37 and 4-38 for all leasing alternatives. The increase in accidents in Colorado for the Low,

TABLE 4-36

TRAFFIC INCREASES
(Movements per Day)

Town	Alternative			
	Low	Moderate	High	Maximum
Craig	0	850	2,500	5,250
Rawlins	0	5,850	7,115	10,600
Rock Springs	800	800	4,950	4,950

TABLE 4-37

ACCIDENT PROJECTIONS FOR COLORADO ROAD SEGMENTS

Road Segment	No Action			Low Production			Moderate Production			High Production			Maximum Production		
	Total Accidents 1992	Total Accidents 1995	Total Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000
A	20	21	22				2	4	4	2	4	4	5	11	11
B	70	75	83				1	2	2	3	5	7	9	13	15
C	109	117	129				1	1	1	4	9	12	12	19	22
D	44	47	50				2	7	7	6	14	14	10	18	18
E	47	49	55				5	15	15	7	19	19	14	29	29
F	40	42	41				5	8	8	6	11	11	8	18	18
G	9	9	11							7	7	7	7	14	14
H	96	105	119							4	8	8	6	10	10
I	49	52	58							5	6	12	3	8	12
J	82	87	98							8	8	13	5	13	16
K	30	31	35	5	9	9	5	9	9	3	9	9	5	9	9
L	10	11	12	1	2	2	1	2	2	1	2	2	1	2	2

NOTE: Accident rates for Colorado were assumed to remain at 1980 levels.

TABLE 4-38

ACCIDENT PROJECTIONS FOR WYOMING ROAD SEGMENTS

Road Segment	No Action			Low Production			Moderate Production			High Production			Maximum Production		
	Total Accidents 1992	Total Accidents 1995	Total Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000	Increased Accidents 1992	Increased Accidents 1995	Increased Accidents 2000
A	399	433	490				6	15	15	8	23	34	8	23	34
B	187	202	230	2	3	3	2	2	2	3	7	14	3	7	14
C	347	377	426	5	8	8	3	5	5	10	20	34	10	20	34
D	93	101	115				1	12	12	5	16	16	7	22	22
E	24	32	37				1	5	5	1	6	6	2	9	9
F	12	13	14				1	2	2	1	2	2	1	4	4
G	35	38	43				2	3	3	2	3	3	5	14	14
H	11	12	14				1	1	1	2	5	6	2	5	6
I	95	102	114				2	4	4	9	21	39	9	21	39
J	41	44	49				1	1	1	1	3	3	1	3	3

NOTE: Accident rates for Wyoming were assumed to remain at 1981 levels.

ENVIRONMENTAL CONSEQUENCES

Moderate, High, and Maximum alternatives is 2, 7, 17, and 25 percent, respectively, while the increases in Wyoming are 1, 3, 10, and 12 percent. The methodology set forth in Chapter 3 was used. Of the total number of accidents projected for the year 2000, two would be fatal accidents in both Colorado and Wyoming under the Maximum alternative. Under the High alternative, one accident in Colorado and two in Wyoming would be fatal. Loss of life and property, or injuries, caused by increases in accidents is a significant impact.

Road maintenance costs would increase as a result of increased average daily traffic. This amount is unquantifiable but it is expected to increase at least proportionately to the increase in average daily traffic.

Approximate road maintenance costs can only be quantified for those roads which would be used to haul coal by truck. Due to the 205 truck trips per day hauling coal on Colorado highway 13/789 from Rattlesnake Mesa to Craig (Moderate through Maximum alternative), maintenance costs would increase by \$504,000 per year. Trucks hauling coal from Bell Rock (Maximum alternative) to Craig would increase maintenance costs on a 1-mile segment of U.S. 40, less than 1 mile of Colorado 13/789 in west Craig, and Moffat County Road 30 by \$154,000 per year. In addition, the Peck Gulch and Williams Fork tracts would require approximately \$400,200 in maintenance costs per year for coal hauled over Routt County roads 59, 61, 29, and 53. These figures are based on 1.4 cents per ton-mile for road maintenance and are over and above taxes and licence fees paid.

Several roads (mostly county) would require upgrading or reconstruction. Total miles of upgraded roads by alternative are: Low, 0; Moderate, 44; High, 57; and Maximum, 100. Construction of new roads would also be required for access to the tracts. Total miles of new roads by alternative are: Low, 7.5; Moderate, 23.5; High, 26.5; and Maximum, 29.0. Offsite transportation needs by tract and alternative are portrayed in Chapter 2.

The proposed rail spur for the Lay Creek Tract (Maximum alternative) would cause another major at-grade crossing to be built on U.S. 40 west of Craig. No data is available to analyze this impact.

Railroads

The Denver and Rio Grande Western and the Union Pacific railroads have indicated that increased rail traffic under the No Action alternative should not exceed track capacity, at least in the near future. Projections are not usually made

beyond a 5- to 10-year period, and due to lack of data no projections for rail traffic have been made. As rail traffic increased in the future, capital investments and maintenance to meet demand would be implemented (personal communication, Union Pacific Railroad and Denver & Rio Grande Western Railroad 1983). Exposure factors and time delays at grade crossings would increase proportionately to rail traffic increases.

Increased unit coal trains would be 0.1, 3.2, 6.2, and 9.6 per day on the Denver and Rio Grande Western Railroad under the Low, Moderate, High, and Maximum Leasing alternatives, respectively. Increases on the Union Pacific Railroad in Wyoming would be 0.3, 6.0, 7.5, and 8.7 under the Low, Moderate, High, and Maximum alternatives, respectively. This assumes Denver and Rio Grande Western trains consist of seventy-five 100-ton cars and Union Pacific trains consist of one hundred 100-ton cars.

The major restriction on the Denver and Rio Grande Western track capacity for trains moving east is the Moffat Tunnel between Bond and Denver, which has a maximum capacity of 48 trains per day. No projections for rail traffic have been made because data is lacking and the railroads generally do not predict traffic past a 5-year period. It is assumed that most of the Colorado coal shipped by rail would travel east and that track capacity would not be reached by the year 2000 through the Moffat Tunnel. Some coal trains may travel west, thus avoiding the Moffat Tunnel and ensuring adequate track capacity.

The Union Pacific Railroad in Wyoming should be able to absorb increased train traffic resulting from the four leasing alternatives (personal communication, Union Pacific Railroad).

Several new rail spurs would be required to connect the tracts with the existing mainlines. New miles of rail spurs required by alternative are: Low, 0; Moderate, 54; High, 65.5; and Maximum, 88.5. Tables in Chapter 2 show the rail spur requirements by tract.

No significant adverse impacts are expected on either of the two railroads as a result of increased coal train traffic.

There are several at-grade crossings involving Denver and Rio Grande Western rail lines that would be affected as a result of the proposed action. No projections for hazard ratings or exposure factors have been made due to lack of data on projected train movements. However, with increased train and highway traffic, the exposure factors would also increase. Grade crossings between the origin and destination point of coal would experience increases in exposure factors and hazard

ENVIRONMENTAL CONSEQUENCES

ratings, time lost waiting at these crossings, and increased noise and safety hazards in towns along the route.

Noise

General noise levels in the region would remain at approximately 40 decibels under the No Action alternative. However, table 4-39 indicates that noise will increase slightly along highways. All figures in the table are estimates--no actual measurements of noise levels were made. The table also shows that with increased noise levels the distance increases from the road to the point where the noise level drops to 50 decibels.

Noise would occur more frequently along rail lines as a result of increased train movements. No projections for railroad noise have been made due to lack of data.

Noise levels can be expected to increase slightly in and around those communities which experience large population increases as well as in and around new mines, power plants, loadouts, and other projects to be developed. These increases would be caused by traffic, construction activities, machinery, and other sources. The amount of time that people, livestock, and wildlife would be exposed to noise would increase.

Increases in on-site noise under the four leasing alternatives would begin with mine construction in 1992. The proposed mines would also increase noise in and around each specific tract. The noise level would be approximately 78 decibels at 500 feet for each surface mine, while underground mines would have noise levels of about 60 to 66 decibels. (Green River-Hams Fork Final EIS 1980). Noise levels at tract boundaries would average around 60 decibels. Several of the Wyoming tracts would have support facilities located off-tract, thus increasing noise in the surrounding area. The effects of the increased noise would be dependent upon any sensitive receptors on or near the tracts, such as residences, wildlife, livestock or people seeking recreation opportunities in the area. The Iles Mountain Tract would increase noise levels in the adjacent Yampa River corridor (Little Yampa Canyon), which would further degrade the tranquility of this river environment. Mining activities along the southern boundary of the Horse Gulch and Signal Butte tracts would also cause short-term increases in noise in the Little Yampa Canyon.

Noise would increase in the communities which would realize large population increases, i.e., Rawlins, Rock Springs, and Craig (Maximum alternative). Most of the increases would be due to in-

creased internal traffic and train traffic. These increases are not quantifiable.

The community of Sinclair would experience increased noise from increased traffic on Seminoe Road due to employee traffic for the Corral Canyon and Wild Horse Draw tracts (Moderate through Maximum alternatives). This increase cannot be quantified due to a lack of traffic data for Sinclair.

Noise along highways would increase as a result of the increased traffic caused by the proposed coal leasing. Table 4-40 shows that increases in noise levels would be low on most of the highway segments analyzed under the Maximum alternative.

The average increase would be 2 decibels along Colorado highways and 1 dB for Wyoming highways. Colorado road segments A, D, F, and G would show increases of 3 to 4 decibels, which is significant because it would be noticeable to and affect residences along these highways within the contour distances shown in table 4-40. Most of the increased noise on segments D and F would be a result of coal truck traffic. Increases in average daily traffic resulting from employee commuting and population growth would increase noise levels on all other road segments. There would be no significant impacts under any alternatives other than Maximum Production in Colorado and no significant increases in noise on Wyoming highways under any of the alternatives. Noise would affect people who live or work within the distances shown in table 4-40 as well as wildlife and livestock.

All of the county roads mentioned in the Transportation section would have increases in noise levels. Those county roads which would be used for hauling coal should experience significant increases in noise, which would affect local ranches and could lower property values.

Noise would occur more frequently along both the Union Pacific and the Denver and Rio Grande Western rail lines under the Moderate, High, and Maximum alternatives as a result of increased train traffic. These increases are not quantified due to a lack of data on train movements, so potential impacts are not known.

Impacts associated with noise include minor physiological reactions; behavioral interference with activities such as speech, sleep, and work; and subjective effects such as annoyance. Increased noise may also affect wildlife or livestock near transportation corridors. In some cases, property values may be lowered.

TABLE 4-39
TRENDED NOISE LEVELS FOR COLORADO & WYOMING HIGHWAYS
NO ACTION ALTERNATIVE

COLORADO							WYOMING						
Road Segment *	Decibels (dB) at 50 feet *			Distance In Feet to the 50 dB contour †			Road Segment *	Decibels (dB) at 50 feet *			Distance In feet to the 50 dB Contour †		
	1992	1995	2000	1992	1995	2000		1992	1995	2000	1992	1995	2000
A	70	70	71	550	550	600	A	80	81	82	1,600	1,850	2,100
B	72	72	73	650	650	700	B	82	82	83	2,100	2,100	2,350
C	73	73	74	700	700	800	C	79	80	81	1,450	1,600	1,850
D	73	73	74	700	700	800	D	80	81	82	1,600	1,850	2,100
E	73	73	74	700	700	800	E	80	80	81	1,600	1,600	1,850
F	73	73	74	700	700	800	F	73	73	74	700	700	800
G	53	53	54	70	70	80	G	72	72	73	650	650	700
H	62	63	64	200	250	300	H	67	67	67	350	350	350
I	62	62	63	200	200	250	I	72	72	73	650	650	700
J	62	62	63	200	200	250	J	70	70	71	550	550	600
K	68	68	69	400	400	450							
L	63	63	64	250	250	300							

SOURCE: Planning In The Noise Environment, U.S. Air Force et al., December 1976.

* Road segments are the same as those portrayed in the Transportation section.

* Estimate is equivalent continuous sound level (L_{eq}) and is based on PHT in Tables T4-1 and T4-2.

† Distance from roadway does not consider barriers such as topography, or other noise sources adjacent to the highway.

TABLE 4-40
INCREASE IN NOISE LEVELS FOR COLORADO & WYOMING HIGHWAYS
MAXIMUM ALTERNATIVE

COLORADO							WYOMING						
Road Segment °	Decibel Increase at 50 feet *			Distance in Feet to the 50 dB contour †			Road Segment °	Decibel Increase at 50 feet *			Distance in feet to the 50 dB Contour		
	1992	1995	2000	1992	1995	2000		1992	1995	2000	1992	1995	2000
A	3	4	3	700	800	700	A	1	1	0	1,850	2,100	2,100
B	1	1	0	700	700	800	B	0	0	0	2,100	2,100	2,350
C	0	0	0	700	700	800	C	0	0	0	1,450	1,600	1,850
D	1	4	3	800	1200	1200	D	1	1	0	1,850	2,100	2,100
E	0	2	1	700	950	950	E	0	0	1	1,600	1,600	2,100
F	1	3	2	800	1100	1100	F	0	2	2	700	950	1,100
G	4	4	4	100	150	150	G	0	1	1	650	700	800
H	1	0	0	250	250	300	H	0	2	2	350	450	550
I	1	1	1	250	250	300	I	1	2	2	700	800	950
J	1	1	1	250	250	300	J	0	0	0	550	550	600
K	1	2	1	450	550	550							
L	1	1	1	300	300	350							

SOURCE: Planning in the Noise Environment, U.S. Air Force et al., December 1976.

° Road segments are the same as those portrayed in the Transportation section.

* Estimate is equivalent continuous sound level (L_{eq}) and is based on PHT in Tables T4-6 and T4-8.

† Distance from roadway does not consider barriers such as topography or other sources adjacent to the highway.

ENVIRONMENTAL CONSEQUENCES

Unavoidable Adverse Effects

Significant adverse impacts that would be unavoidable are:

1. Increased internal traffic in Craig, Rawlins, and Rock Springs under the High and Maximum alternatives
2. Large increases in traffic through the community of Sinclair beginning with the Moderate alternative
3. Increased traffic congestion on U.S. 40 and Colorado 13/789 in West Craig under the Maximum alternative due to development of the Bell Rock Tract

Potentially significant impacts due to large increases in traffic would occur under the Maximum alternative on Moffat County Roads 17, 30, 33, and 47; on Routt County Roads 27, 53, 59, and 61; on Seminole Road and 20-Mile Road in Carbon County; and on Sweetwater County Roads 4-15, 4-18, and 4-76.

Significant increases in noise would occur along U.S. 40 and Colorado 13/789 near Craig and along Colorado 317 under the Maximum alternative. County roads used for coal hauling and access may also experience significant increases in noise. Potential impacts frequency due to increased occurrence of noise along rail lines are unknown.

Short-Term Use vs. Long-Term Productivity

Short-term use of roads would require upgrading of these routes. These improvements would enhance the long-term usability of the transportation system in the region.

Irreversible or Irretrievable Commitments of Resources

Loss of life and property or injuries as a result of increased traffic accidents would be irretrievable. Materials and disturbed areas for new permanent

roads and railroads would be irretrievably committed.

Potential Mitigation

Once the transportation plan was submitted (see Appendix 6, All Colorado and Wyoming Tracts, Item 4), the regulatory authority could require mitigation to minimize any adverse impacts associated with the transportation plan. Possible mitigation would probably emphasize off-highway transportation of coal or reimbursement of maintenance costs.

NET ENERGY ANALYSIS

A net energy analysis was conducted for each of the proposed lease tracts. The study was designed to trace all energy used to extract and ship the coal to an end user and determine the amount of energy which could be produced from the coal. In other words, the analysis quantified the inputs and outputs of energy and materials of the production process. Energy inputs included electricity, fuels, haulage, reclamation, and supplies for the mining operation itself, as well as product transportation, employee transportation, and infrastructure energy requirements. Because no mining plans were available at this stage of the coal leasing effort, the study assumed a 'generic' mine plan. All of the energy inputs were assigned values based on this plan. Since no coal markets were identified, the study also assumed a rail transport distance of 1,000 miles.

Table 4-41 gives the ratio, in British Thermal Units, or BTUs, between production and consumption for each tract. Surface mines averaged 21.65:1 while subsurface mines averaged 15.32:1, indicating that subsurface mines are less efficient.

A net energy figure is not given for the Indian Springs Tract since this is designated for in situ development rather than conventional mining. This tract is projected for coal gasification and will require further NEPA approvals. A more meaningful net energy analysis can be made at that time.

TABLE 4-41
NET ENERGY SUMMARY

Tract	Ratio (BTUs) Output:Input	
Deadman	39.7 :	1
Leucite Hills	39.7 :	1
Point of Rocks	13.27:	1
Tract 98	19.25:	1
Prairie Dog	19.1 :	1
Little Middle Creek	25.0 :	1
Middle Creek	25.92:	1
Atlantic Rim	28.13:	1
Byrne Creek	16.61:	1
Corral Canyon	27.52:	1
Wild Horse Draw	7.93:	1
Rattlesnake Mesa	23.3 :	1
Signal Butte	23.63:	1
Pio	8.99:	1
Winton	10.40:	1
Indian Springs		*
Peck Gulch	10.97:	1
Iles Mountain	24.73:	1
Fish Creek	23.54:	1
Northeast Cow Creek	10.73:	1
Bell Rock	25.35:	1
Williams Fork Mountain	22.06:	1
Lay Creek	23.38:	1
Horse Gulch	22.66:	1

*Not meaningful; see Net Energy narrative.

CHAPTER 5

PUBLIC PARTICIPATION

Introduction

Public involvement has been a key element in all of the steps leading to the publication of this environmental impact statement (EIS). Public involvement techniques have ranged from informal meetings to formal public hearings, with numerous requests for specific information also being responded to. The following list highlights public participation activities.

Land Use Planning Scoping Meetings

White River land use plan amendment (1981-Denver, Meeker, Rangely, Grand Junction)
Williams Fork land use plan amendment (1981-Craig, Denver, Steamboat Springs)
Divide/Overland Area management framework plan (MFP) Update (1982-Baggs, Saratoga, Rawlins)
Big Sandy MFP Decision (1981-Rock Springs)
Salt Wells MFP Decision (1981-Rock Springs)
Pioneer Trails MFP Amendment (1981-Kemmerer)

Regional Coal Team Meetings

Cheyenne, Wyoming - January 28, 1982; January 11 & 12, 1983
Denver, Colorado - March 31, 1981; June 16, 1982; October 13, 1982

Expressions of Interest (industry)

For different planning units - January 1982 through June 6, 1982

Scoping Meetings

Denver, Colorado: January 24, 1983
Rawlins, Wyoming: January 25, 1983
Rock Springs, Wyoming: January 26, 1983
Craig, Colorado: January 27, 1983

In addition to the meetings listed above, many informal meetings were held for consultation purposes with various Federal, state, and local agencies. A broad range of one-on-one meetings have been held by the many Bureau specialists assigned to the project. The information received has been incorporated into the EIS as appropriate.

Formal consultation for the EIS comprised (1) consultation with the Fish and Wildlife Service under Section 7 of the Endangered Species Act of 1979 concerning nationally listed threatened or endangered species, and (2) consultation with the Colorado and Wyoming State Historic Preservation Officers under Section 106 of the National Historic Preservation Act. The Craig, Rawlins, and Rock Springs districts were responsible for carrying out these formal consultations for their respective areas. Results of these consultations are discussed in Chapter 3 under Vegetation, Animal Life, and Cultural Resources.

Distribution of Draft EIS

Copies of this EIS have been sent to the Federal agencies listed below, as well as to local governments in the region, energy and mineral development companies, environmental organizations, universities, and numerous individuals concerned about the outcome of the coal leasing process. Review of the draft EIS by the state agencies is being coordinated through the Colorado and Wyoming state clearinghouses.

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
Forest Service

PUBLIC PARTICIPATION

Soil Conservation Service
Department of Energy
Department of Housing and Urban Development
Department of the Interior
Bureau of Mines
Bureau of Reclamation
Fish and Wildlife Service
Geological Survey
National Park Service
Office of Surface Mining (cooperating agency)
Department of Transportation
Environmental Protection Agency

List of Preparers

CAROL A. MacDONALD - Team Leader

M.A. (1970) American Literature, University of Denver

B.A. (1966) English, University of Denver

Experience: 4 years as environmental coordinator, including 2-1/2 years as coal EIS team leader, BLM, New Mexico; 1 year as coal EIS technical coordinator, BLM, Colorado; 2 years as writer-editor, BLM, Colorado; 2 years teaching, Washington University, St. Louis; 3 years as editor, University of Denver.

SCOTT ARCHER - Climate and Air Quality

B.S. (1977) Environmental Science and Chemistry, Northern Arizona University, Flagstaff, Arizona

Experience: 1-3/4 years as air quality specialist, BLM, Colorado; 4-1/2 years as consultant, EPA.

GEORGE E. BATESON - Land Use and Reclamation

B.S. (1979) Range Management and Resources, University of Idaho

Experience: 1 year as range conservationist, BLM, Colorado; 2 years as surface reclamation specialist, BLM, Colorado; 6 months as range technician (coal reclamation), BLM, Colorado;

1-1/2 years as forest technician, U.S. Forest Service.

DAVID BRAY - Technical Coordinator

M.S. (1977) Biology, Fort Hays Kansas University

B.S. (1968) Agriculture, Fort Hays Kansas State College

Experience: 2 years as coal coordinator, BLM, Colorado; 2-1/2 years as energy minerals rehabilitation inventory and analysis coordinator, BLM, Colorado; 4-1/2 years as range conservationist, Soil Conservation Service, Idaho and Texas; 1 year as supervisory range researcher, Biological Science Department, Fort Hays Kansas University.

HERBERT CONLEY, JR. - Animal Life

M.S. (1976) Wildlife Biology, Colorado State University

B.S. (1974) Wildlife Biology, Colorado State University

Experience: 6 years as wildlife management biologist, BLM, Colorado; 1 year as wildlife technician, BLM, Colorado; 1 year as wildlife researcher, private environmental consulting company, Fort Collins, Colorado; 1 year as wildlife research assistant, Colorado State University.

DAVID COOPER - Recreation, Wilderness, Visual Resources, Transportation, Noise, Net Energy Analysis

B.S. (1975) Forestry (Outdoor Recreation), Southern Illinois University at Carbondale

Experience: 3 years as outdoor recreation planner/wilderness coordinator, BLM, Colorado; 2 years as park ranger, U.S. Army Corps of Engineers, Oregon; 2 years as forest technician, U.S. Forest Service, Idaho; 1-1/2 years as park naturalist, U.S. Army Corps of Engineers, Illinois.

DAVIDA ('PETE') GATES - Social Values

Ph.D. (1977) Sociology, University of North Carolina, Chapel Hill, N.C.

PUBLIC PARTICIPATION

M.A. (1966) Anthropology, University of Colorado, Boulder

M.A. (1964) Sociology, University of North Carolina, Chapel Hill

A.B. (1952) Sociology, Catawba College, Salisbury, N.C.

Experience: 3-1/2 years as district sociologist, BLM, Colorado; 1 year as Arkansas State Prevention Coordinator for Drug and Alcohol Prevention; 12 years of university teaching; 8 years of public school teaching; 12 years as office clerical manager, bookkeeper, and statistician.

GREGORY S. GOODENOW - Environmental Coordinator

B.S. (1978) Forest Management Science, Colorado State University

Experience: 2-1/2 years as environmental coordinator, BLM, Colorado; 3-1/2 years as forester, BLM, Colorado.

TERRY L. HUETH - Soils

B.S. (1976) Range Ecology, Colorado State University, Fort Collins, Colorado

Experience: 4 years as soil scientist, BLM, Colorado; 2 years as range conservationist, BLM, Idaho.

RICHARD R. INGLIS, JR. - Water Resources

B.S. (1973) Science of Watershed Management, Colorado State University

Experience: 4 years as district hydrologist, BLM, Colorado; 2-1/2 years as volunteer with Soil Conservation Program, Peace Corps, El Salvador; 2 years as forestry technician, BLM, Colorado.

HENRY S. KEESLING - Cultural Resources

M.A. (1977) Anthropology, California State University, Sacramento

B.A. (1974) Anthropology, California State University, Sacramento

Experience: 2 years as resource area archaeologist, BLM, Colorado; 3-3/4 years as crew chief, Forestry Archaeological Project, Bureau of Indian Affairs, New Mexico; 6 years with various private and state archaeological consulting firms in Alaska, California, Nevada, Wyoming, and Colorado.

BERTHA E. McMILLEN - Editorial Clerk

Experience: 3 years as editorial clerk, training clerk, and safety clerk, BLM, Colorado; 1 year as administrative supply technician, Colorado Army National Guard; 2-3/4 years as administrative secretary, The Memorial Hospital; 7 years as office manager, private industry; 1 year as writer-editor, U.S. Navy, Washington, D.C.; 1 year as clerk-stenographer, Bureau of Reclamation, Colorado.

GAYLE VOSS-RETTMANN - Clerk-Typist

Business/Music, Colorado State University and Western State College

Experience: 1 year as clerk-typist and Amtext 425 word processor operator, BLM, Colorado; 2 years as co-teacher, Craig Middle School; 1 year as secretary and administrative assistant, United Presbyterian Church, Montrose, Colorado; 1 year as steno-typist, Montrose City Hall; 1 year as clerk, Montrose Regional Library, Montrose, Colorado; 2 years as Colorado clerk-typist, Fort Lewis College Library, Durango, Colorado.

LEIGH A. WELLBORN - Cartography

B.S. (1951) Architecture, University of Kansas

Experience: 8 years as illustrator, BLM, Colorado State Office; 23 years as architect, draftsman, and illustrator, U.S. Air Force.

KAREN WILEY-EBERLE - Vegetation

B.S. (1978) Botany, Colorado State University

PUBLIC PARTICIPATION

Experience: 5 years as district botanist, BLM, Colorado; 1 year as range conservationist, student trainee program, BLM, Colorado.

DAVID G. WILLARD - Economics

M.A. (1962) Economics, University of Denver

B.S. (1954) Beloit College

Experience: 3 years as district economist, BLM, Colorado; 8 years as mineral economist, Bureau of Mines; 4 years as business economist, private industry; 1 year as research economist, Denver Urban Renewal Authority; 3 years as agricultural economist, Bureau of Reclamation.

KERMIT G. WITHERBEE - Geology, Topography, and Minerals

M.A. (1978) Geology, State University of New York

B.S. (1968) Geology, State University of New York

Experience: 1 year as geologist, BLM, Colorado; 6 years as geologist, private industry; 1 year as geologist, BLM, Wyoming.

ROBERT E. WOERNER - Editor

B.A. (1969) English, Grand Valley State College, Michigan

Experience: 1 year as editor, BLM, Colorado; 1 year as RMP team leader and district environmental coordinator, BLM, Nevada; 1 year as editor, BLM, Nevada; 1 year as editor, BLM, Colorado.

Cooperating Agency

The Office of Surface Mining Reclamation and Enforcement (OSM) assisted directly in the preparation of this EIS as a cooperating agency. OSM's primary responsibilities were to (1) provide information on hydrology and reclamation, including background information on existing coal mines in the area as needed; (2) review draft documents to identify areas of concern regarding OSM's permitting activities which could feasibly be addressed in the EIS; and (3) help identify mitigating measures within OSM's regulatory authority.

APPENDIX 1

TRACT RANKING FACTORS AND SUBFACTORS

The following factors and subfactors were used in the tract ranking process. Table A1-1 shows the results of tract ranking.

FACTOR: COAL ECONOMICS

Subfactors

Coal Quantity: To what extent does the tract contain tonnages of measured, demonstrated, indicated, and inferred reserves?

Coal Quality: To what extent does coal in tract have preferable measurements of heating value (Btu content); fixed carbon; moisture; ash; sulfur; phosphorus; major, minor, and trace elements; coking properties; and particular organic constituents?

Energy Production Potential: To what extent is tract economically feasible and likely to be developed--e.g., surface mine: overburden ratio, number of seams, size; underground mine: seam thickness, roof conditions, floor conditions, depth?

Transportation: Proximity of mine to expected use or transportation facility, including mine-mouth, existing rail, planned rail, or truck.

Surface Ownership: To what extent will surface ownership affect mining costs for the tract? Indicators include number of owners, complexity of ownership pattern, the nature of surface facilities which may have to be moved or otherwise protected, etc.

FACTOR: IMPACTS TO THE NATURAL ENVIRONMENT

Subfactors

Air Quality: To what extent is the tract (1) near Class I and/or Class II designated air quality areas or (2) near residences? What is its potential for dust generation?

Water: To what extent will coal mining degrade or reduce groundwater or contribute significant additional pollutants to surface water flow? What is the location of the coal seam with rela-

tion to aquifers? What are the location and size of perennial and intermittent streams within tract?

Reclamation Potential: To what extent is land within the tract capable of being returned to a condition which is equal to or better than premining conditions? Some items to be considered are the amount of precipitation, the availability of soil materials for reclamation, the presence of toxic overburden constituents, etc.

Wildlife: To what extent would coal mining adversely affect threatened and endangered species or other species of high concern and their critical habitats?

Archaeology: To what extent will mining adversely affect archaeological resources? Indicators of impact include archaeological resources known to exist on a tract, likely to exist from inferred data, located adjacent to the tract, or known not to exist on the tract. These indicators may be of unique, significant, or average levels.

Paleontology: See Archaeology.

Historic: See Archaeology.

Other Unique Resources: To what extent will unique resources be affected? Examples include wilderness values, state designated areas, areas of critical environmental concern (ACEC's), etc.

Transportation: To what extent does a proposed transportation system for the tract affect the surrounding environment?

FACTOR 3: SOCIAL AND ECONOMIC IMPACTS

Subfactors

Public Attitudes: Indication by the public for or against coal mining and specific correspondence on tracts. Concerns expressed during land use planning and coal activity planning.

Revenue Generation: To what extent will mining of the tract result in revenues from bonus bids, Federal and state royalties, severance taxes, permitting fees, state annual reclamation fees,

Table A1-1

RANKING BY REGIONAL COAL TEAM

Tract	Ranking	Comments
<u>COLORADO</u>		
Prairie Dog	High	Socioeconomic impact because of new mine related population increases (Rangely and Dinosaur)
Little Middle Creek	High	Maintenance tract
Middle Creek	High	Tract is a fault block
Rattlesnake Mesa	High	Lack of transportation from the area
Signal Butte	High	Wildlife and other unique resources present, potential reclamation problems, and development of new transportation
Peck Gulch	Moderate	Lack of transportation--residence located on tract--potential hydrology impact
Iles Mountain	Moderate	Potential reclamation problems--wildlife and other unique resources present, such as recreation/floatboating on the Yampa River
Fish Creek	Moderate	New mine related population increases (Oak Creek and Yampa)--unknown impacts to alluvial valley floors--one residence to be relocated and potential hydrology impacts
Bell Rock	Moderate	No tract access to coal except by shaft--lack of transportation--diverse surface ownership pattern--two residences located on tract--potential hydrology impacts
Williams Fork Mountain	Moderate	Lack of transportation, diverse surface ownership, marginal stripping ratio and steep topography--wildlife, diverse surface and water situation--alluvial valley floor on tract, loss of one grazing operation and significant impact to another
Lay Creek	Moderate	Lack of transportation--diverse surface ownership--conservation of resource--potential wildlife and reclamation problems--alluvial valley floor and lambing areas
Horse Gulch	Low	Coal <10,000 BTU and low in quantity--high ratio of disturbance to coal recovered--lack of transportation--unknown impact to alluvial valley floors and springs, wildlife, visual quality related to Yampa River recreation--relocation of occupants and Federal power project withdrawal

Table A1-1
(Continued)

RANKING BY REGIONAL COAL TEAM

Tract	Ranking	Comments
<u>WYOMING</u>		
Deadman	High	Maintenance tract
Leucite Hills	High	Possible extension of Jim Bridger Mine--some wildlife mitigation required
Point of Rocks	High	Involved in possible exchange--possible extension of Leucite Hills Mine
Tract 98	High	Maintenance tract
Atlantic Rim	High-Moderate	Pending development of suitable mitigation and clearing pending status
Byrne Creek	Moderate	Possible alluvial valley floors--pending mitigation development
Corral Canyon	High	Exchange tract
Wild Horse Draw	Moderate	Dependent on Corral Canyon--wildlife mitigation required--short mine life
Pio	Moderate	Contains important wildlife values and marginal coal
Winton	Moderate	Logical extension of Stansbury Mine--subsurface tract, low economics of underground mining
Indian Springs	Moderate	In situ gasification--state has no ranking preference
Northeast Cow Creek	Low	Long distance from transportation routes--critical elk area, pending study for wildlife values--underground tract, overall economics of underground mining is poor

TRACT RANKING

abandoned mine fees, increased employment, and other taxes?

Lifestyle and Social Structure: To what extent will coal mining adversely affect traditional lifestyles and social structures?

Community and Social Services: To what extent will coal mining affect availability of doctors, nurses, hospital beds, police and fire protection, sewer, domestic reserve water supply, etc.?

Consistency With Other Plans and Policies: To what extent will coal mining adversely impact

or contradict local, state, or Federal land use policies and plans?

Agricultural Operations: To what extent will coal mining adversely affect alluvial valley floors or prime farmlands?

Relocation of Occupants: To what extent will coal mining require the relocation of people and their possessions, including livestock, houses, fences, etc.? Indicators include whether the move is permanent or temporary, partial or total, distance to relocation point, and length of time before return to original location (for temporary relocations).

APPENDIX 2

SUMMARY OF INDIVIDUAL TRACTS

Introduction

This appendix provides a summary of pertinent information, including significant impacts or issues, for the individual tracts being considered for leasing. Additional information can be found in Chapter 2.

For purposes of impact analysis in the EIS, all except three tracts are considered to be new mines. The other three tracts--Little Middle Creek Tract in Colorado and Tract 98 and Deadman Tract in Wyoming--are analyzed as extensions of existing mines. The only other alternative for each tract is no action (no leasing).

However, during site-specific analysis, more than one scenario was considered for a number of the tracts. Table A2-1 lists the tracts and the scenarios evaluated for each.

The following summaries emphasize the impacts or issues associated with the development scenario used in the EIS, in most cases development of a new mine. Impacts of another development scenario are discussed only if significant impacts were identified.

For all tracts under all development scenarios, the coal mined (recoverable reserve) would be an irretrievable commitment of the resource. Coal left behind would be unrecoverable with present technology.

For all tracts, mine-related surface disturbance would be subject to Federal and state reclamation requirements in the long term. Secondary surface disturbance (community development due to population increases) would not be reclaimed in the long term and is considered an irreversible commitment of the affected land.

In most cases, site-specific impacts of the No Action alternative would be the same for all tracts. Coal development would not occur, and the various ancillary facilities would not be constructed. The coal resource would not be extracted or used. The tract would stay under its present land use management and existing social, economic, and resource trends would continue. Any additional impacts for specific tracts are identified in the appropriate individual summaries on the following pages.

DEADMAN TRACT

General location: Sweetwater County, 35 miles northeast of Rock Springs, Wyoming

Tract size (acres): 160.0

Surface ownership: 100% Federal

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 3.4

Total recoverable reserve (million tons): 0.3

Annual production (million tons): 0.3

Mine life (years): 1

Mine-related disturbance (acres): 80

Secondary surface disturbance (acres): None

Transportation: No new transportation required

Significant Impacts or Issues

Reclaimability of soils in the area is limited by high sodium adsorption values, low available moisture storage, and high pH values. Reclamation will depend on the lessee developing specific mitigation to handle expected revegetation problems.

A prehistoric site (potentially eligible for the National Register) is a significant cultural resource known to exist on the Deadman tract. A cultural resource protection stipulation will be required if leased.

Short-term impacts of mining this tract could include:

1. The production of 0.27 million tons of Federal coal
2. Change in use of approximately 80 acres of land from livestock grazing to mineral development
3. Generation of additional estimated revenues of \$155,000 in ad valorem production taxes and \$240,000 in severance taxes, plus \$454,000 in federal royalties during the life of the mine

TABLE A2-1
LEASING SCENARIOS ANALYZED
IN SITE SPECIFIC ANALYSES*

<u>Tract</u>	<u>Scenarios</u>
Deadman	Extension of existing surface mine
Leucite Hills	Extension of existing surface mine New surface mine
Point of Rocks	Extension of existing surface mine New surface mine
Tract 98	Extension of existing surface mine
Atlantic Rim	New surface mine
Byrne Creek	New surface mine
Corral Canyon	New surface mine
Wild Horse Draw	New surface mine
Pio	New surface mine
Winton	New underground mine
Indian Springs	New in-situ gasification project
Northeast Cow Creek	New underground mine
Prairie Dog	Extension of existing underground mine New underground mine
Little Middle Creek	Extension of existing surface mine
Middle Creek	Extension of existing underground mine New underground mine
Rattlesnake Mesa	Extension of existing underground mine New underground mine
Signal Butte	New surface and underground mine
Peck Gulch	New underground mine

Table A2-1
(continued)

LEASING SCENARIOS ANALYZED
IN SITE SPECIFIC ANALYSES*

<u>Tract</u>	<u>Scenarios</u>
Iles Mountain	New surface mine
Fish Creek	Extension of existing surface and proposed underground mine New surface and underground mine
Bell Rock	Extension of existing underground mine New underground mine
Williams Fork Mtn.	New surface mine
Lay Creek	New surface mine
Horse Gulch	New surface mine

*In addition to the leasing scenarios, a no action (no leasing) scenario was analyzed for each tract.

SUMMARY OF INDIVIDUAL TRACTS

4. Discovery of previously unknown cultural resources

In the long term, the following impacts are predicted:

1. A return of 80 acres of land to forage production at a level equal to, if not better than, the production prior to development
2. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

LEUCITE HILLS TRACT

General location: Sweetwater County, 30 miles northeast of Rock Springs, Wyoming

Tract size (acres): 4,682.5

Surface ownership: 52% Federal, 48% private

Mineral ownership: 52% Federal, 48% private

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 97.1

Total recoverable reserve (million tons): 17.7

Annual production (million tons): 0.5

Mine life (years): 35

Mine-related disturbance (acres): 3,667

Secondary surface disturbance (acres): 36

Transportation: 5.5 miles of new road

Significant Impacts or Issues

Reclaimability of soils in the area is limited by high sodium adsorption values, low available moisture storage, and high pH values. Reclamation will depend on the lessee developing specific mitigation to handle expected revegetation problems.

Raptor nests and buffer zones occur within privately held portions of the Leucite Hills tract.

Approximately 330 acres of a 450-acre prehistoric district located in the northern part of the tract would be disturbed by mining activities. A cultural resource protection stipulation will be required if leased.

Although within the 24-hour ambient standards, total suspended particulate impacts due to an off-tract processing facility would be high.

Short-term impacts of mining this tract could include:

1. The production of 6.5 million tons of Federal coal
2. Change in use of approximately 4,682 acres of land from livestock grazing to mineral development
3. Generation of additional estimated revenues (1980 dollars) of \$323,000 in ad valorem coal production taxes and \$499,000 in coal severance taxes, plus \$308,000 in Federal coal royalties per year during the production from the Leucite Hills Mine area
4. Discovery of previously unknown cultural resources
5. Removal of approximately 240 livestock forage AUMs from production due to development of a new mine on the tract

In the long term, the following impacts are predicted:

1. A return of 4,682 acres of land to forage production at a level equal to, if not better than, the production prior to development
2. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

POINT OF ROCKS TRACT

General location: Sweetwater County, 25 miles east of Rock Springs, Wyoming

Tract size (acres): 4,016.3

Surface ownership: 50% Federal; 38% private; 12% state

Mineral ownership: 50% Federal; 38% private; 12% state

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 47.9

Total recoverable reserve (million tons): 17.5

Annual production (million tons): 0.5

Mine life (years): 30

Mine-related disturbance (acres): 2,800

Secondary surface disturbance (acres): 18

Transportation: 2.0 miles of new road

SUMMARY OF INDIVIDUAL TRACTS

Significant Impacts or Issues

Reclaimability of soils in the area is limited by high sodium adsorption values, low available moisture storage, and high pH values. Reclamation will depend on the lessee developing specific mitigation to handle expected revegetation problems.

Three known geologic structures (KGSs) were included in the MMS delineation of the Point of Rocks tract. Conflicts will be mitigated under existing statutory and regulatory authority.

Twelve existing rights-of-way were identified in the tract. The area was determined to be suitable for development subject to valid existing rights and negotiations for relocation if necessary.

An exchange of Federal sections in the northern half of this tract is being considered.

Golden eagle and prairie falcon nests and buffer zones occur within portions of the Point of Rocks tract, as delineated by MMS. BLM found that coal unsuitability criteria 11, 13, and 14 apply to these nesting areas. No exceptions could be made to this determination and the area has been removed from the tract; no mining activities would be allowed on these unsuitable portions. The 500,000 tons of coal bypassed due to the determination of the unsuitable areas for surface mining would be uneconomic to produce at a later time.

Short-term impacts of mining this tract could include:

1. The production of 13.6 million tons of Federal coal
2. Change in use of approximately 4,016 acres of land from livestock grazing to mineral development
3. Generation of additional estimated revenues (1980 dollars) of \$300,000 in ad valorem coal production taxes and \$463,000 in coal severance taxes, plus \$653,000 in Federal coal royalties per year during the production from the Leucite Hills Mine area
4. Discovery of previously unknown cultural resources

In the long term, the following impacts are predicted:

1. A return of 4,016 acres of land to forage production at a level equal to, if not better than, the production prior to development

2. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

TRACT 98

General location: Lincoln County, 3 miles west of Kemmerer, Wyoming

Tract size (acres): 164.8

Surface ownership: 100% Federal

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 3.8

Total recoverable reserve (million tons): 3.4

Annual production (million tons): 0.5

Mine life (years): 7

Mine-related disturbance (acres): 165

Secondary surface disturbance (acres): None

Transportation: No new transportation required

Significant Impacts or Issues

As part of the adjacent South Block Mine, this tract may fall under exemption in the regulations for special bituminous surface coal mines. If so, the highwall left by mining Tract 98 would remain and the pit would be left open and allowed to partially fill with water.

Short-term impacts of mining this tract could include:

1. The production of 3.4 million tons of Federal coal
2. Change in use of approximately 165 acres of land from livestock grazing to mineral development
3. Generation of additional estimated revenues of \$1,852,000 in ad valorem production taxes and \$2,992,000 in severance taxes, plus \$5,950,000 in Federal royalties during the life of the mine
4. Discovery of previously unknown paleontological resources

SUMMARY OF INDIVIDUAL TRACTS

In the long term, the following impacts are predicted:

1. Under the worst-case analysis, 80 acres of land would be returned to forage production and wildlife habitat at a level equal to, if not better than, the production and habitat prior to development. Should the pit be covered, 160 acres of land would be returned to forage production and wildlife habitat.

ATLANTIC RIM TRACT

General location: Carbon County, 15 miles southwest of Rawlins, Wyoming

Tract size (acres): 9,372.4

Surface ownership: 45% Federal, 55% private

Mineral ownership: 39% Federal, 53% private, 8% state

Type of mine: Surface

Rank of coal: Subbituminous A

Total coal resource (million tons): 382.2

Total recoverable reserve (million tons): 178.2

Annual production (million tons): 5.4

Mine life (years): 30

Mine-related disturbance (acres): 7,880

Secondary surface disturbance (acres): 160

Transportation: 21.0 miles of upgraded road; 19.0 miles of new rail

Significant Impacts or Issues

There are three significant issues involved in this tract: (1) crucial elk winter range, (2) hydrologic impacts, and (3) reclamation.

The Atlantic Rim tract is part of an elk crucial winter range. Up to 550 elk (19 percent of the herd) winter on and near the tract. The elk crucial winter range contains the highest quality coal in the Divide Resource Area. The land-use decision for all of the coal in this crucial winter range, including the Atlantic Rim surface coal tract, states that BLM will defer a determination on the acceptability or unacceptability of the coal areas (concerning both surface and subsurface mining methods) within the crucial elk winter range until there is adequate information for the elk habitat and a final determination has been made regarding the leasing of the Savery PRLAs.

However, despite this deferment, the Atlantic Rim surface coal mining area and Northeast Cow Creek

subsurface coal mining area are now being given consideration for coal leasing through the coal activity planning process, including calls for expressions of leasing interest, tract delineation, site specific analysis, and the Green River-Hams Fork Regional Coal Environmental Impact Statement (EIS).

The rationale for this variation is based on comments received from state and local governments. State and local governments expressed a concern that if, subsequent to the elk study, the Atlantic Rim surface coal mining area were to be determined acceptable for coal development, the area could not be included in the coal activity planning process to allow it to be leased by or soon after the 1984 lease sale unless the steps delineated in the preceding paragraph were completed first.

The Northeast Cow Creek subsurface coal mining area was included for consideration with the Atlantic Rim surface coal mining area because: (1) the state of Wyoming has already issued several coal leases in the area; and (2) the area is located in the northern portion of the elk crucial winter range and is consistent with the land-use planning decision for a north-to-south leasing and mining sequence.

This variation in the deferral does not imply that these two areas within the crucial elk winter range are the most likely areas to be acceptable for coal development. Given the inadequacy of data regarding the crucial winter range, the determination of the acceptability or unacceptability of any coal area within that range must and will be deferred until adequate data is available for the elk crucial winter range and final disposition of the Savery PRLA project is known.

BLM will ask for any additional resource data within the crucial winter range that it needs. This additional information will then be combined with the results of the elk study and the information gained on Atlantic Rim and Northeast Cow Creek and will be considered along with the Savery PRLA area to reach the final determination for the crucial elk winter range.

A surface mine on the Atlantic Rim tract could significantly affect groundwater and surface water in the vicinity. If mining were to begin near the outcrops and proceed down dip, the water table could be lowered. If the water table was lowered, numerous springs would become dry, which would, in turn, destroy aspen stands and other important wildlife habitat on- and off-site.

The destruction of these habitat types would complicate reclaiming the tract to present vegetation mosaic and diversity. If these habitat types are not replaced, there would be potentially significant impacts to wildlife.

SUMMARY OF INDIVIDUAL TRACTS

Short-term impacts of mining this tract could include:

1. The production of 178.1 million tons of coal
2. Change in use of about 7,900 acres from livestock/wildlife grazing to coal development, with the corresponding loss of grazing capacity
3. Creation of an additional 48 jobs during construction and 346 jobs during production
4. Generation of additional revenues of \$586,000,000 in ad valorem and severance taxes and Federal royalties

In the long term, the following impacts are predicted:

1. Approximately 204 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would be returned to present land use management, assuming that nonfederal lands were returned to prior use.
3. Social and economic impacts would be short-lived; in the long term, the capacity of communities to deal with larger populations would result.
4. Reclamation requiring a return of 7,900 disturbed acres to a premining condition would void any impact to long-term productivity or the visual resource.

BYRNE CREEK TRACT

General location: Uinta County, 10 miles east of Evanston, Wyoming

Tract size (acres): 2,230.0

Surface ownership: 19% Federal, 77% private, 4% state

Mineral ownership: 39% Federal, 57% private, 4% state

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 71.2

Total recoverable reserve (million tons): 15.8

Annual production (million tons): 0.5

Mine life (years): 30

Mine-related disturbance (acres): 2,260

Secondary surface disturbance (acres): 36

Transportation: 4.0 miles of new road

Significant Impacts or Issues

Sediment loads and erosion rates in the Albert Creek watershed currently are high and surface disturbance could result in significant increases. The lessee will design an erosion control plan acceptable to the BLM and Wyoming DEQ. A potential alluvial valley floor occurs within the tracts; final determination will be made by Wyoming DEQ and OSM.

Reclaimability of disturbed areas in the Byrne Creek tract is limited due to climatic conditions and poor soil properties. Reclamation will depend on the lessee developing specific mitigation to handle expected revegetation problems.

Potential for black-footed ferret habitat exists on the tract. Ferret searches and resulting habitat protection/recovery will be required.

Lands adjacent to Albert Creek are recognized as high probability areas for significant prehistoric sites. A cultural resource protection stipulation will be required if leasing occurs.

Increased traffic levels at the junction of U.S. 189 and I-80 would increase the probability of traffic accidents.

MMS delineated 90 acres in the southeast quarter of Section 10, T. 16 N., R. 118 W. BLM found that coal unsuitability criterion 13 applied to this 90 acres due to the presence of a prairie falcon nest. No exceptions could be made to this determination and the area has been removed from the tract; no mining activities would be allowed on this 90 acre area.

Short-term impacts of mining this tract could include:

1. The production of 6.04 million tons of Federal coal
2. Change in use of approximately 2,320 acres of land from livestock grazing to mineral development
3. Generation of additional estimated revenues (1980 dollars) of \$307,000 in ad valorem coal production taxes and \$497,000 in coal severance taxes, plus \$335,000 in Federal coal royalties per year
4. Discovery of previously unknown cultural resources

SUMMARY OF INDIVIDUAL TRACTS

In the long term, the following impacts are predicted:

1. A return of 2,230 acres of land to forage production at a level equal to, if not better than, the production prior to development
2. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

CORRAL CANYON TRACT

General location: Carbon County, 15 miles northeast of Rawlins, Wyoming

Tract size (acres): 3,440.0

Surface ownership: 29% Federal, 71% private

Mineral ownership: 29% Federal, 71% private

Type of mine: Surface

Rank of coal: High volatile C bituminous to subbituminous A

Total coal resource (million tons): 83.0

Total recoverable reserve (million tons): 72.2

Annual production (million tons): 2.4

Mine life (years): 30

Mine-related disturbance (acres): 2,647

Secondary surface disturbance (acres): 93

Transportation: 6.0 miles of new road, 10.0 miles of upgraded road, 3.0 miles of new rail

Significant Impacts or Issues

There is one significant issue involving this tract: the Corral Canyon-Grand Teton National Park land exchange.

This land exchange is a proposal for an exchange of lands between the Rocky Mountain Energy Company (RME) and the Federal government. The purpose of the Federal government in considering this proposal is to acquire 754.95 acres of private land within Grand Teton National Park. This land would be placed under the jurisdiction of the National Park Service (NPS). The purpose for RME is to acquire 1,000 acres of Federal land that is intermingled with RME land in a checkerboard pattern. This would give RME a solid block of land as a logical mining unit.

The exchange is being actively considered. However, the Corral Canyon tract is also being processed for potential coal development. If the ex-

change is effected, the coal tract would be dropped from further consideration for coal leasing.

Short-term impacts of mining this tract could include:

1. Seventy-two million tons of Federal coal would be produced.
2. A total of 2,300 acres would change from livestock/wildlife grazing to coal development, with the corresponding loss of grazing capacity.
3. An additional 20 jobs would be created during construction and 202 jobs during production.
4. Additional revenues of \$165,000,000 in ad valorem and severance taxes and Federal royalties would be generated.

In the long term, the following impacts are predicted:

1. Approximately 11 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would be returned to present land use management, assuming that nonfederal lands were returned to prior use.
3. The social and economic impacts would be short-lived; in the long term, communities would be able to deal with larger populations.
4. Reclamation requiring a return of 2,300 disturbed acres to a premining condition would void any impact to long-term productivity or the visual resource.

WILD HORSE DRAW TRACT

General location: Carbon County, 8 miles northeast of Rawlins, Wyoming

Tract size (acres): 2,560.0

Surface ownership: 50% Federal, 50% private

Mineral ownership: 50% Federal, 50% private

Type of mine: Surface

Rank of coal: Subbituminous A to high volatile C bituminous

Total coal resource (million tons): 23.7

Total recoverable reserve (million tons): 12.1

Annual production (million tons): 1.7

Mine life (years): 7

SUMMARY OF INDIVIDUAL TRACTS

Mine-related disturbance (acres): 1,520
Secondary surface disturbance (acres): 75
Transportation: 6.0 miles of new road, 13.0 miles of upgraded road, 14.0 miles of new rail

Significant Impacts or Issues

There are no significant impacts associated with development of this tract.

Short-term impacts of mining this tract could include:

1. The production of 12 million tons of Federal coal
2. Change in use of about 975 acres from livestock/wildlife grazing to coal development, with the corresponding loss of grazing capacity
3. The creation of an additional 14 jobs during construction and 164 jobs during production
4. Generation of additional revenues of \$33,000,000 in ad valorem and severance taxes and Federal royalties

In the long term, the following impacts are predicted:

1. Approximately 12 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would return to present land use management.
3. The social and economic impacts would be short-lived; in the long term, communities would be able to deal with larger populations.
4. Reclamation would return the 975 acres to a pre-mining condition and would void any significant impact to long-term productivity or the visual resource.

PIO TRACT

General location: Sweetwater County, 35 miles south of Rock Springs, Wyoming

Tract size (acres): 5,624.7

Surface ownership: 100% Federal

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 133.4

Total recoverable reserve (million tons): 11.1

Annual production (million tons): 0.5

Mine life (years): 22

Mine-related disturbance (acres): 2,884

Secondary surface disturbance (acres): 36

Transportation: 1.0 mile of new road, 7.0 miles of new rail

Significant Impacts or Issues

A large part of the Pio tract is used by mule deer as winter range. Surface mining could have a significant impact on the deer. The area would be acceptable for coal development subject to the acceptance of a habitat recovery and replacement plan.

Reclaimability of disturbed areas in the tract is limited due to climatic conditions and poor soil properties. Reclamation will depend on the lessee developing specific mitigation to handle expected revegetation problems.

The proposed rail spur to this tract follows a portion of the Rock Springs/Brown's Park Stage Road. A cultural resource protection stipulation will be required, if leased.

A known geologic structure (KGS) was included in the MMS delineation of the Pio tract. Conflicts will be mitigated under existing statutory and regulatory authority.

Loss of AUMs has been determined to be a significant issue. This loss could have a significant effect on the viability of the affected cattle operation.

Short-term impacts of mining this tract could include:

1. The production of 11.1 million tons of Federal coal
2. Change in use of approximately 2,700 acres of land from livestock grazing to mineral development for the entire life of the mine
3. Generation of additional estimated revenues (1980 dollars) of \$344,000 in ad valorem coal production taxes and \$440,000 in coal severance taxes, plus \$840,000 in Federal coal royalties per year
4. Discovery of previously unknown cultural resources

SUMMARY OF INDIVIDUAL TRACTS

In the long term, the following impacts are predicted:

1. A return of 2,700 acres of land to forage production at a level equal to, if not better than, the production prior to development
2. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

WINTON TRACT

General location: Sweetwater County, 8 miles north of Rock Springs, Wyoming

Tract size (acres): 6,161.3

Surface ownership: 29% Federal, 71% private

Mineral ownership: 29% Federal, 71% private

Type of mine: Subsurface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 138.7

Total recoverable reserve (million tons): 69.4

Annual production (million tons): 2.0

Mine life (years): 37

Mine-related disturbance (acres): 105

Secondary surface disturbance (acres): 239

Transportation: 4.2 miles of new rail

Significant Impacts or Issues

Subsidence over a broad area within the tract due to subsurface mining was identified as a potentially controversial issue. Anticipated future land uses (livestock grazing and wildlife habitat) are not expected to be significantly impacted by subsidence.

Golden eagle, ferruginous hawk, and prairie falcon nests and buffer zones occur within the Winton tract. The lessee will protect existing raptor nests and their buffer zones within the tract as well as migratory bird habitat pertinent to application of coal unsuitability criteria Nos. 11, 12, 13, and 14. Any exceptions granted for support facilities may be allowed only by permission of the authorized officer.

Significant on-tract prehistoric cultural resources may be adversely affected by impacts due to increased occupancy of the area. A cultural resource protection stipulation will be required, if leased.

Increased traffic at the junction of U.S. 191 and old U.S. 87 would increase the potential of accidents.

Short-term impacts of mining this tract could include:

1. The production of 19.63 million tons of Federal coal
2. Change in use of approximately 82 acres of land, including about 10 acres of Federal land, from livestock grazing to mineral development
3. Creation of 524 operational jobs and 480 indirect employment opportunities in Sweetwater County, resulting in the use of 883 housing units in Rock Springs, Green River, and South Superior, and increased annual school enrollments of 524 in School District No. 1 and 324 in School District No. 2
4. Generation of additional revenues of \$1.965 million in ad valorem taxes and \$3.035 million in severance taxes, plus \$1.098 million in Federal royalties each year starting in the year 2000
5. Discovery of previously unknown cultural resources

In the long term, the following impacts are predicted:

1. A return of at least 54 acres of land to forage production at a level equal to, if not better than, the production prior to development (except for railroad bed disturbance of 28 acres, which may not be reclaimed)
2. An increased use of transportation systems, railroads, and highways in support of the mineral industry
3. A return of wildlife habitat to a level equal to, if not better than, the habitat prior to development

INDIAN SPRINGS TRACT

General location: Carbon County, 6 miles west of Rawlins, Wyoming

Tract size (acres): 2,435.4

Surface ownership: 57% Federal, 43% private

Mineral ownership: 57% Federal, 43% private

Type of mine: In situ gasification

Rank of coal: Subbituminous A and B

SUMMARY OF INDIVIDUAL TRACTS

Total coal resource (million tons): 86.1
Total recoverable reserve (million tons): 49.0
Annual production (million tons): 1.2
Mine life (years): 41
Mine-related disturbance (acres): 200
Secondary surface disturbance (acres): 69
Transportation: 15.0 miles of pipeline

Significant Impacts or Issues

This tract is proposed for in situ gasification.

In situ coal gasification is a developing technology that allows coal energy to be recovered without mining. The coal is burned underground. The burn is sustained by oxygen and steam injected into the burn area through injection wells. When coal is burned in the presence of steam, it results in the production of methane, carbon monoxide, and carbon dioxide gases. The gases are brought to the surface through a production well. This combination of gases can be used as a low energy fuel. In addition, they can be separated and further processed into natural gas and other by-products.

The proposed development at Indian Springs would involve the operation of some 20 coal burn areas (modules) at any given time. Each module consists of two injection wells and one production well. The drill pads for the three wells in each module would require use of about 0.1 acre. In addition to the 20 operating modules, another 5 modules would be under construction while 5 other modules would be undergoing reclamation. The wells would be connected by a small diameter pipe to the gas gathering plant.

The project is estimated to last about 30 to 40 years and could employ 150 persons. The modules would likely be developed in two groupings (10 modules each) along the strike (outcrop) of the coal seam. One grouping would begin at the edge of the project area; as old modules burned out and new ones were developed, it would advance toward the center of the project area. The other groups of modules would begin near the center of the project and advance toward the opposite edge.

The annual Prevention of Significant Deterioration Class II sulfur dioxide increment was predicted to be exceeded by the proposed Indian Springs facility. These results are too preliminary to be used for regulatory purposes; further analysis would be required during detailed development review.

Short-term impacts of mining this tract could include:

1. The consumption of 49 million tons of coal
2. Change in use of about 2,435 acres from livestock/wildlife grazing to coal development, with a corresponding loss of grazing capacity
3. Creation of an additional 260 jobs during construction and 150 jobs during production
4. Generation of additional revenues of \$363,000,000 in ad valorem and severance taxes and Federal royalties

In the long term, the following impacts are predicted:

1. Approximately 37 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would be returned to present land use management, assuming that non-Federal lands were reclaimed to prior use.
3. The social and economic impacts would be short-lived; in the long term, communities would be able to deal with larger populations.
4. Reclamation requiring a return of 200 disturbed acres to a premining condition would void any impact to long-term productivity or the visual resource.

NORTHEAST COW CREEK TRACT

General location: Carbon County, 30 miles southwest of Rawlins

Tract size (acres): 8,323.0

Surface ownership: 86% Federal, 12% private, 2% state

Mineral ownership: 88% Federal, 10% private, 2% state

Type of mine: Subsurface

Rank of coal: Subbituminous A to high volatile C

Total coal resource (million tons): 212.1

Total recoverable reserve (million tons): 91.6

Annual production (million tons): 1.8

Mine life (years): 50

Mine-related disturbance (acres): 460

Secondary surface disturbance (acres): 226

SUMMARY OF INDIVIDUAL TRACTS

Transportation: 1.5 miles of new road, 26.0 miles of upgraded road, and 16.0 miles of new rail

Significant Impacts or Issues

There are two potentially significant issues involved in this tract: (1) crucial elk winter range and (2) hydrologic impacts.

The Northeast Cow Creek tract is part of a crucial elk winter range. The elk crucial winter range contains the highest quality coal in the Divide Resource Area. The land use planning decision for all of the coal areas in this crucial winter range, including the Northeast Cow Creek, states that the Bureau will defer a determination on the acceptability or unacceptability of the coal areas (concerning both surface and subsurface mining methods) within the crucial elk winter range until there is adequate information for the elk habitat and a final determination has been made regarding the leasing of the Savery PRLAs.

However, despite this deferment, the Atlantic Rim surface coal mining area and Northeast Cow Creek subsurface coal mining are now being given consideration for coal leasing through the coal activity planning process, including calls for expressions of leasing interest, tract delineation, site specific analysis, and the Green River-Hams Fork Regional Coal Environmental Impact Statement (EIS)

The rationale for this variation is based on comments received from state and local governments. State and local governments expressed a concern that if, subsequent to the elk study, the Atlantic Rim surface coal mining area were to be determined acceptable for coal development, the area could not have been included in the coal activity planning process to allow it to be leased by or soon after the 1984 lease sale unless the steps delineated in the preceding paragraph were completed first.

The Northeast Cow Creek subsurface coal mining area was included for consideration with the Atlantic Rim surface coal mining area because: (1) the state of Wyoming has already issued several coal leases in the area; and (2) the area is located in the northern portion of the elk crucial winter range and is consistent with the land use planning decision for a north-to-south leasing and mining sequence.

This does not imply that these two areas within the crucial elk winter range are the most likely areas to be acceptable for coal development. Given the inadequacy of data regarding the crucial winter range, the determination of the acceptability or unacceptability of any coal area within that range must and will be deferred until adequate data is

available for the elk crucial winter range and final disposition of the Savery PRLA project is known.

The underground water on this tract contains flammable gas under pressure. This gas could be released during mining operations and pose hazards to miners.

Subsidence is not expected to be a significant impact on the surface values of this area, although it may make the recovery of some of the surface mineable coal reserves infeasible.

Short-term impacts of mining this tract could include:

1. The production of 91.6 tons of coal
2. Change in use of about 800 acres from livestock/wildlife grazing to coal development, with the corresponding loss of grazing capacity
3. Creation of an additional 125 jobs during construction and 492 jobs during production
4. Generation of additional revenues of \$613,000,000 in ad valorem and severance taxes and Federal royalties

In the long term, the following impacts are predicted:

1. Approximately 120 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would be returned to present land use management.
3. The social and economic impacts would be short-lived, and, in the long term, communities would be able to deal with larger populations.
4. Reclamation requiring a return of 800 disturbed acres to a premining condition would void any impact to long-term productivity or the visual resource.

PRAIRIE DOG TRACT

General location: Rio Blanco County, 7 miles northeast of Rangely, Colorado

Tract size (acres): 11,517.9

Surface ownership: 100% Federal (except for 1.6 acres)

Mineral ownership: 100% Federal

Type of mine: Subsurface

SUMMARY OF INDIVIDUAL TRACTS

Rank of coal: High volatile C bituminous
Total coal resource (million tons): 147.4
Total recoverable reserve (million tons): 43.9
Annual production (million tons): 1.0
Mine life (years): 40
Mine-related disturbance (acres): 150
Secondary surface disturbance (acres): 55
Transportation: 3.5 miles of new conveyor

Significant Impacts or Issues

The site specific analysis identified significant or controversial impacts for economics, sociology, and reclamation if the Prairie Dog Tract is leased and a new mine is developed.

Economic and social impacts would be moderately significant to Rangely and somewhat less significant to Dinosaur. Mine construction is projected to increase Rangely's population by six percent and Dinosaur's by three percent, increasing to nine percent and six percent at full production, respectively. The increase in population would create problems in housing, community facilities, and social services in both communities.

The re-establishment of the plant community similar to the existing one would be costly for the 40 acres that would be disturbed for facilities and portals. The factors identified that could affect successful revegetation are steep slopes, high clay content of the soil, shallow topsoil, coarse fragments in the soil, salts, sodium, and selenium. These limitations could be mitigated by reclamation regulations.

It should be noted that Western Fuels Association, Inc., the company expressing interest in the tract, may qualify as a public body bidder. The above-mentioned impacts would not occur if the Secretary designated this tract as a special leasing opportunity for public bodies because the tract would be developed as an extension of an existing mine.

The Prairie Dog Tract would not be offered for lease under the No Action Alternative and the coal resource not developed. Off-site impacts could result from this action if both units of the Moon Lake Power Plant were constructed; this is discussed in more detail in the Moon Lake EIS. Briefly, the Deserado Mine would be 15 years short (existing leases) of the reserves necessary to supply the power plant.

This action would lend to the open market purchase of coal and associated transportation of the coal. There is the possibility that the tract could be

leased under the No Action alternative if the Deserado Mine becomes eligible for emergency leasing.

Short-term impacts of mining this tract could include:

1. The production of 44.0 million tons of Federal coal
2. Change in use from livestock and wildlife grazing to coal development on 40 acres
3. Creation of an additional 270 jobs
4. Generation of additional revenues of \$2.4 million annually in ad valorem taxes, severance taxes, and Federal royalties

In the long-term, the following impacts are predicted:

1. Forty-four million tons of coal resource would be unrecoverable with present technology.
2. Reclamation would require a return of 40 disturbed acres to forage production equal to or greater than that which existed before development.
3. The social and economic impacts would be short-lived; in the long term, the capacity of the communities to deal with a larger population would result.

LITTLE MIDDLE CREEK TRACK

General location: Routt County, 6 miles west of Oak Creek, Colorado

Tract size (acres): 990.9

Surface ownership: 25% Federal, 75% private

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 15.0

Total recoverable reserve (million tons): 12.8

Annual production (million tons): 3.3

Mine life (years): 4

Mine-related disturbance (acres): 700

Secondary surface disturbance (acres): None

Transportation: No new transportation required

SUMMARY OF INDIVIDUAL TRACTS

Significant Impacts or Issues

The site specific analysis found no significant or controversial impacts, although three important impacts were identified. These impacts are to wildlife reproduction areas, a prehistoric/historic cultural site, and short-term salt loading of Foidel Creek.

The impact of mining on wildlife reproduction areas could be mitigated by special lease stipulation and is described in more detail in the site specific analysis, Section 7.1.5 The impact to the cultural site cannot be determined at this time, but could range from none to 100 percent, depending on mining activities. The salt loading of Foidel Creek should return to approximately pre-mine levels shortly after the completion of mining.

The Little Middle Creek tract could be leased as an emergency lease to Colorado-Yampa Coal Company to avoid a coal bypass under the No Action alternative and was consequently incorporated in the baseline analysis. The impacts of this action are essentially the same as those described above for the development alternative.

If the tract is not leased, the area could stay under its present land use management, livestock/wildlife grazing. This would result in a continuation of the existing impacts to the resources within the tract.

Not leasing this tract could shorten the life of the existing mine, and the 24.8 million tons of recoverable coal in the tract could be bypassed. This tract encompasses the remaining surface mineable coal in the area. The adjoining surface mine is presently mining the existing lease on tract. If the coal in this tract is not leased during this round of leasing, the existing mining operation would be gone from the area by the next round of leasing. There are not sufficient quantities of unleased surface mineable coal left in the area for the existing company to come back and mine economically, nor for a new company to come in at a later date.

Short-term impacts of mining this tract could include:

1. The production of 12.8 million tons of Federal coal
2. Change in use of 991 acres from livestock/wildlife grazing to coal development

In the long-term, the following impacts are predicted:

1. Approximately 2.2 million tons of coal resource would be unrecoverable with present technology.

2. A total of 991 acres would be returned to livestock/wildlife use.

MIDDLE CREEK TRACT

General location: Routt County, 5 miles west of Oak Creek, Colorado

Tract size (acres): 1,080.0

Surface ownership: 4% Federal, 96% private

Mineral ownership: 100% Federal

Type of mine: Subsurface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 26.6

Total recoverable reserve (million tons): 5.5

Annual production (million tons): 0.1

Mine life (years): 55

Mine-related disturbance (acres): 10

Secondary surface disturbance (acres): 4

Transportation: No new transportation required

Significant Impacts or Issues

No significant or controversial impacts were found during the site specific analysis; however, six important impacts were noted. The important impacts are listed below and are discussed in more detail in the site specific analysis of Middle Creek tract.

1. Trout Creek and Little Middle Creek floodplains are located within the tract. However they are protected through lease stipulations.
2. Four surface water rights occur on or adjacent to the tract and are not expected to be impacted.
3. Fifteen springs occur within the tract. Potential impacts are considered to be minor since mining will be subsurface.
4. The Trout Creek alluvial valley floor occurs within the tract and is protected by its designation as a floodplain.
5. The presence of shallow topsoil and clayey subsoil may pose reclamation problems for the area disturbed for facilities. Lease stipulations should mitigate this problem.
6. Approximately 10 acres (surface facilities) of VRM Class II area will be changed to interim management Class V until successful reclamation is achieved.

SUMMARY OF INDIVIDUAL TRACTS

Short-term impacts of mining this tract could include:

1. A total of 5.5 million tons of Federal coal would be produced.
2. Surface facilities would remove 10 acres from livestock/wildlife grazing.
3. Twenty additional jobs would be created.
4. Ad valorem and severance taxes and Federal royalties would generate \$300,000 of additional revenues annually.

In the long-term, the following impacts are predicted:

1. Five and one-half million tons of coal would be unrecoverable with present technology.
2. A return of 10 acres of land to livestock/wildlife grazing at a level equal to or greater than before development would occur.

RATTLESNAKE MESA TRACT

General location: Rio Blanco County, 5 miles north-east of Meeker, Colorado

Tract size (acres): 936.2

Surface ownership: 38% Federal, 62% private

Mineral ownership: 100% Federal

Type of mine: Subsurface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 117.7

Total recoverable reserve (million tons): 36.0

Annual production (million tons): 0.9

Mine life (years): 40

Mine-related disturbance (acres): 80

Secondary surface disturbance (acres): 47

Transportation: No new transportation required

Significant Impacts or Issues

The site specific analysis did not identify any significant or controversial impacts.

Short-term impacts of mining this tract could include:

1. The production of 36 million tons of Federal coal

2. Change in use of 45 acres of land from livestock/wildlife grazing to coal development

3. Creation of an additional 220 jobs

4. Generation of additional revenues of \$2.5 million annually from ad valorem taxes, severance taxes, and Federal royalties

In the long-term, the following impacts are predicted:

1. The return of 45 acres of land to forage production at a level equal to or greater than before development would occur.
2. Approximately 81.7 million tons of coal would be unrecoverable because of limitations in present coal mining technology.

SIGNAL BUTTE TRACT

General location: Moffat County, 16 miles west of Craig, Colorado

Tract size (acres): 3,137.0

Surface ownership: 6% Federal, 94% private

Mineral ownership: 100% Federal

Type of mine: Surface and subsurface

Rank of coal: Data not available

Total coal resource (million tons): 257.8

Total recoverable reserve (million tons): 79.9

Annual production (million tons): 2.0 (surface) and 1.2 (subsurface)

Mine life (years): 61 (9 - surface and 52 - subsurface)

Mine-related disturbance (acres): 1,400

Secondary surface disturbance (acres): 68

Transportation: 18.0 miles of new rail

Significant Impacts or Issues:

The site specific analysis identified two reclamation problems not normally addressed in reclamation plans: (1) soluble salts occurrence in the topsoil and (2) wind erosion. A lessee's reclamation plan will have to develop specific mitigation for dealing with these problems.

A significant beneficial impact would result from increased revenue for Moffat County.

SUMMARY OF INDIVIDUAL TRACTS

Sights and sounds created from surface mining would degrade the natural, undeveloped quality of the Little Yampa Valley canyon.

Short-term impacts of mining this tract could include:

1. The production of 79.9 million tons of Federal coal
2. Change in use of 3,137 acres from livestock/wildlife grazing to coal development
3. Creation of an additional 75 jobs during construction, and 170 jobs during surface production, which would increase to 500 jobs during underground production
4. Generation of additional revenue of \$6,600,000 in ad valorem and severance taxes and Federal royalties
5. The loss of 502 animal unit months of grazing annually

In the long term, the following impacts are predicted:

1. Approximately 65.6 million tons of coal reserves unrecoverable using present technology
2. A return of the tract to present land use management
3. Short-lived social and economic impacts offset by the long-term capacity of communities to deal with larger populations
4. Reclamation requiring a return of the 1,082 acres of disturbance to a premining condition, thus mitigating any impact to long-term productivity or the visual resource

PECK GULCH TRACT

General location: Moffat County, 10 miles southeast of Craig, Colorado

Tract size (acres): 1,923.0

Surface ownership: 9% Federal, 91% private

Mineral ownership: 100% Federal

Type of mine: Subsurface

Rank of coal: Subbituminous A

Total coal resource (million tons): 112.8

Total recoverable reserve (million tons): 36.7

Annual production (million tons): 1.2

Mine life (years): 30.5

Mine-related disturbance (acres): 120

Secondary surface disturbance (acres): 81

Transportation: 2.0 miles of new road, 13.0 miles of upgraded road

Significant Impacts or Issues

The site specific analysis identified increased revenue for Moffat County as a beneficial significant impact. Cumulative impacts of simultaneously leasing adjacent tracts containing mule deer, elk, and sage grouse habitat present a problem; committed mitigation has been developed to lessen this impact.

Air quality impacts due to processing facilities near the proposed tract boundary are predicted to exceed the 24-hour total suspended particulate ambient air quality standard. Further analysis would be required during detailed development review to prevent this impact.

Short-term impacts of mining this tract could include:

1. The production of 36.7 million tons of coal
2. Change in the use of 40 acres from livestock/wildlife grazing to coal development
3. The creation of an additional 120 jobs during construction and 300 jobs during production
4. Generation of additional revenues of \$3,100,000 annually in ad valorem and severance taxes and federal royalties

In the long term, the following impacts are predicted:

1. Approximately 36.7 million tons of coal resource unrecoverable using present technology
2. A return of the tract to its present land use management
3. Short lived social and economic impacts offset by the long-term capacity of communities to deal with larger populations

ILES MOUNTAIN TRACT

General location: Moffat County, 12 miles southwest of Craig, Colorado

Tract size (acres): 2,847.4

Surface ownership: 34% Federal, 66% private

SUMMARY OF INDIVIDUAL TRACTS

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous A

Total coal resource (million tons): 38.2

Total recoverable reserve (million tons): 33.5

Annual production (million tons): 1.7

Mine life (years): 20

Mine-related disturbance (acres): 1,180

Secondary surface disturbance (acres): 40

Transportation: 0.3 miles of new rail

Significant Impacts or Issues:

The site specific analysis identified the loss of 17 percent, and possibly an additional 13 percent, of grazing use in one allotment. This would be considered a significant loss to the operator of that allotment.

Other important issues identified are: (1) The requirement for considerable amounts of overburden for reclamation and (2) removal of critical elk and deer winter ranges. Both would require the lessee's reclamation plan to develop specific mitigation dealing with these problems.

In addition, the quality of the visual and recreational resource would be diminished to the recreational user on the Yampa River.

The short-term impacts of mining this tract could include:

1. The production of 33.5 million tons of Federal coal
2. Change in use of 2,847 acres from livestock/wildlife grazing and farming to coal development
3. Creation of an additional 60 jobs during construction and 140 jobs during production
4. Generation of additional revenues of \$5,400,000 annually in ad valorem and severance taxes and Federal royalties
5. The loss of 377 animal unit months of grazing (677 without mitigation), which would significantly impact one grazing allotment for approximately 30 years

In the long term, the following impacts are predicted:

1. Approximately 4.5 million tons of coal resource would be unrecoverable with present technology
2. Reclamation requiring a return of 1,180 disturbed acres to a premining condition, mitigating any impact to long-term productivity or the visual resource
3. A return of the tract to present land use management
4. Enhanced capacity of local communities to deal with larger populations

FISH CREEK TRACT

General location: Routt County, 12 miles northwest of Oak Creek, Colorado

Tract size (acres): 2,856.5

Surface ownership: 100% private

Mineral ownership: 100% Federal

Type of mine: Surface and subsurface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 138.7

Total recoverable reserve (million tons): 64.3

Annual production (million tons): 1.0

Mine life (years): 64 (3 - surface and 61 - subsurface)

Mine-related disturbance (acres): 325

Secondary surface disturbance (acres): 65

Transportation: No new transportation required

Significant Impacts or Issues

The site specific analysis identified several significant impacts under Development Alternative. Routt County would benefit economically from mine-generated taxes and additional revenues generated from an increase in population. The increase in population would significantly affect both Oak Creek and Phippsburg. The impact would be of low significance because of a projected small growth rate for Phippsburg and the high social readiness of Oak Creek.

An important impact would be the exclusion of about 150,000 tons of coal that underlies a permanent residence within the tract. However, the coal

SUMMARY OF INDIVIDUAL TRACTS

could be mined if the lessee was able to purchase the property.

An unknown potential impact could occur to the Fish Creek alluvial valley floor (AVF). Direct impacts to the AUF on-tract are not anticipated; however, the impact of tract development on the water supply to the alluvial valley floor off-tract is not known.

The presence of three golden eagle nests has resulted in the designation of a 280-acre buffer zone as unsuitable for surface occupancy and mining. Surface mining of coal would not be precluded since mineable coal is not present within the buffer zone. Subsurface coal mining should not impact the nesting area, since no surface disturbance is expected, given the depth of mining and competency of the overburden.

Surface mining is expected to increase the salt load contributed to Fish Creek. This would return to premining levels shortly after reclamation was completed.

In an effort to lessen cumulative impacts of simultaneously leasing adjacent tracts containing mule deer; elk; and sharp-tailed, blue, and sage grouse reproduction areas and golden eagle nesting areas, mitigation has been committed in the form of special leasing stipulations.

The 24-hour total suspended particulate ambient air quality standards are predicted to be exceeded from processing facilities emissions on and off tract at the proposed Fish Creek Tract. These potential impacts would be mitigated during detailed development planning and other permitting reviews.

The Fish Creek Tract, in conjunction with existing Federal and private leases, surrounds a 480-acre parcel of unleased Federal coal that is estimated to contain 4.7 million tons of potentially recoverable subsurface coal. Land use planning for consideration for coal development has not been initiated for this 480-acre parcel.

Short-term impacts of mining this tract could include:

1. The production of 64.3 million tons of Federal coal
2. Removal of 2,856 acres from livestock/wildlife grazing and farming
3. An additional 45 jobs during construction and 80 jobs during surface mining, which would increase to 250 during underground mining
4. Ad valorem taxes, severance taxes, and Federal royalties generating additional revenues of \$9,000,000

Long-term impacts predicted could include:

1. Approximately 74.4 million tons of coal resources would be unrecoverable with present technology.
2. The tract would be returned to present land use management.
3. The social and economic impacts would be short-lived. The Communities would have the capacity to deal with larger populations and the services required.
4. Reclamation would return tract disturbances to a premining productivity.

BELL ROCK TRACT

General location: Moffat County, 7 miles southwest of Craig, Colorado

Tract size (acres): 1,935.1

Surface ownership: 11% Federal, 72% private, 17% state

Mineral ownership: 100% Federal

Type of mine: Subsurface

Rank of coal: High volatile C bituminous

Type of mine: Subsurface

Rank of coal: High volatile C bituminous

Total coal resource (million tons): 199.7

Total recoverable reserve (million tons): 43.4

Annual production (million tons): 1.0

Mine life (years): 43

Mine-related disturbance (acres): 95

Secondary surface disturbance (acres): 66

Transportation: 6.0 miles of upgraded road

Significant Impacts or Issues

The site specific analysis found one significant impact and two impacts requiring mitigation.

The coal does not outcrop on tract, in an area suitable for surface disturbance; it requires 900-to 1,500-foot shafts to access the coal. This makes the tract uneconomical or technically infeasible for development of a new mine.

In an effort to lessen cumulative impacts of simultaneously leasing adjacent tracts containing mule deer, golden eagles and red-tailed hawk re-

SUMMARY OF INDIVIDUAL TRACTS

production areas, mitigation has been committed in the form of a special lease stipulation.

Two residences on tract would require protection from subsidence through protective stipulations.

The No Action alternative would result in the tract not being offered for lease and the coal not developed. Residential development in the area could result in an increased number of residences within the tract boundaries. The coal resource could be impacted by the No Action alternative. If the coal was developed at a later date, an undetermined amount of coal would be precluded from mining to protect surface residences and associated structures.

The short-term impacts of mining this tract would include:

1. The production of 43.4 million tons of Federal coal
2. Change in use of 50 acres of land from farming and livestock/wildlife grazing to coal development
3. Creation of an additional 250 jobs
4. Generation of additional revenues of \$2,500,000 annually in ad valorem and severance taxes and Federal royalties

In the long term, the following impacts are predicted:

1. Approximately 43 million tons of coal resource would be unrecoverable with present technology.
2. Reclamation would require returning the disturbed 50 acres to a production level equal to or greater than predisturbance, mitigating any impact to long-term productivity
3. The social and economic impacts would be short-lived; in the long term, the capacity of the communities to deal with a larger population would result.

WILLIAMS FORK MOUNTAIN TRACT

General location: Moffat and Routt counties, 10 miles southeast of Craig, Colorado

Tract size (acres): 9,946.1

Surface ownership: 2% Federal, 98 % private

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous A

Total coal resource (million tons): 45.9

Total recoverable reserve (million tons): 39.0

Annual production (million tons): 1.3

Mine life (years): 30

Mine-related disturbance (acres): 3,982

Secondary surface disturbance (acres): 30

Transportation: 11.0 miles of upgraded road

Significant Impacts or Issues

The site specific analysis identified one significant and four important impacts. One livestock operation would lose 85 percent of its grazing use over the 30-year mining/reclamation period. This would be considered a significant impact to that operation and could not be mitigated because of the nature of the surface ownership rights.

The other four issues are as follows:

1. Existing rights-of-way could preclude the recovery of approximately 315,000 to 415,000 tons of coal.
2. An impact to the visual resource would prevail beyond end of mine life.
3. Two floodplains on the tract could preclude the recovery of approximately 1.06 million tons of coal.
4. An impact to noise levels from transportation activities would prevail to end of mine life.

The short-term impacts of mining this tract could include:

1. The production of 39 million tons of Federal coal
2. Change in use of 9,946.1 acres from livestock/wildlife grazing and farming to coal development
3. Creation of an additional 60 jobs during construction and 100 jobs during production
4. Generation of additional revenues of \$4,200,000 annually in ad valorem and severance taxes and Federal royalties
5. The loss of 1,665 animal unit months of grazing annually
6. The economic loss of one ranching operation until reclamation is complete and land use reverted back to grazing

SUMMARY OF INDIVIDUAL TRACTS

7. An increase in transportation noise of approximately 30 Leq dB on Routt County Road 59/61

In the long term, the following impacts are predicted:

1. Approximately 6.9 million tons of coal reserves would be unrecoverable with present technology.
2. Reclamation requiring a return of the 3,982 acres of disturbance to a premining condition would mitigate any impact to long-term productivity or the visual resource.
3. A return of the tract to present land use management would occur.
4. The social and economic impacts would be short-lived; in the long term, the capacity of communities to deal with larger populations would result.
5. A return of the noise level on Routt County Road 59/61 to premining levels would occur.
6. The right-of-way for a 345 kV power transmission line and a gas pipeline would preclude production of 315,000 to 415,000 tons of coal with present technology.
7. The unsuitability decision for Jeffway Gulch and Spring Gulch flood plains would preclude the development of 1.06 million tons of coal in the long term with present technology.

LAY CREEK TRACT

General location: Moffat County, 16 miles northwest of Craig, Colorado

Tract size (acres): 9,961.9

Surface ownership: 15% Federal, 79% private, 6% state

Mineral ownership: 88% Federal, 6% private, 6% state

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 59.2

Total recoverable reserve (million tons): 50.3

Annual production (million tons): 1.7

Mine life (years): 30

Mine-related disturbance (acres): 2,451

Secondary surface disturbance (acres): 45

Transportation: 7.0 miles of new rail

Significant Impacts or Issues

Site specific analysis identified three potential reclamation problems not normally occurring within the Yampa Coal Field: (1) soluble salts occurrence in the topsoil, (2) high sodium and soluble salts occurrence in the overburden, and (3) wind erosion. A lessee's reclamation plan will have to develop specific mitigation for dealing with these problems.

The tract is cut in two by a floodplain/alluvial valley floor area which has been determined unsuitable for surface disturbance or occupancy. As a result, the tract would be mined as two separate units, and it is uncertain whether the lessee would be allowed to connect the two units with haul roads, access roads, etc.

The Lay Creek tract was delineated as a tract in the first round of leasing in the Green River-Hams Fork coal region. At that time, the tract encompassed 11,861 acres with 69.4 million tons of recoverable Federal reserves, all surface mineable coal in the area. As a result of delineation of unsuitable areas (golden eagles and ferruginous hawks, 1982 MFP amendment) and development of lease stipulations limiting surface disturbance and occupancy (golden eagles and sage grouse), the tract was redelineated as 9,962 acres with 50.3 million tons of recoverable Federal reserves. Therefore, approximately 19 million tons of recoverable Federal reserves would be left underground in scattered areas throughout the tract. This 19 million tons is considered an irretrievable loss of the resource.

The economic analysis determined a moderately significant beneficial impact to Moffat County's revenues.

The wildlife analysis identified a significant impact to a golden eagle nest if mitigation was not committed to protect the nest.

In an effort to lessen cumulative impacts of simultaneous leasing, mitigation to offset loss of mule deer, elk, antelope, and sage grouse habitat will be required in the form of special leasing stipulations.

Short-term impacts of mining this tract could include:

1. The production of 50.3 million tons of Federal coal.
2. Change in use of 9,962 acres from livestock/wildlife grazing and farmland to coal development.
3. Creation of an additional 75 jobs during construction and 170 jobs during production.

SUMMARY OF INDIVIDUAL TRACTS

4. Generation of additional revenues of \$6,200,000 in ad valorem and severance taxes and Federal royalties. This would be a moderately beneficial impact for Moffat County.
5. The loss of 1,088 animal unit months of grazing annually.
6. The economic loss of three critical lambing areas until reclamation is complete and land use reverts back to lambing areas. The three ranch operators affected have been tentatively identified as qualified surface owners who would have the choice of whether to be compensated for the impacts or not permit mining.

In the long term, the following impacts are predicted:

1. Approximately 9 million tons of coal reserves would be unrecoverable with present technology.
2. Approximately 19 million tons of coal reserves would be left in scattered areas possibly uneconomical to mine.
3. A return of the tract to present land use management and vegetative productivity would occur.
4. The social and economic impacts would be short-lived; in the long term, local communities would have a greater capacity to deal with larger populations.

HORSE GULCH TRACT

General location: Moffat County, 12 miles southwest of Craig, Colorado

Tract size (acres): 4,117.0

Surface ownership: 41% Federal, 59% private

Mineral ownership: 100% Federal

Type of mine: Surface

Rank of coal: Subbituminous B

Total coal resource (million tons): 8.3

Total recoverable reserve (million tons): 7.1

Annual production (million tons): 0.5

Mine life (years): 15

Mine-related disturbance (acres): 1,243

Secondary surface disturbance (acres): 13

Transportation: 1.0 mile of new road

Significant Impacts or Issues

No significant impacts were identified as a result of the site specific analysis; however, several important and controversial impacts were discovered.

Soluble salts in the topsoil and the potential for wind erosion would pose reclamation problems for the tract. The lessee's reclamation plan would have to contain mitigation for these problems.

Horse Gulch, Sand Spring Gulch, and Fuhr Gulch have been identified as floodplains unsuitable for surface occupancy. Since the floodplains are unsuitable for surface occupancy and disturbance, approximately 1.5 million tons of recoverable coal would be precluded from development. Access roads would not be allowed to be constructed across the floodplains, resulting in the tract being divided into four units.

Alluvial valley floors (AVF) have been identified along the stream channels of Horse Gulch, Sand Spring Gulch, and Fuhr Gulch. No impact to their surface is expected because they are protected by their designation as floodplains. The potential for impacts to the groundwater recharge system to the AVFs and springs is not known. Special performance standard 30 CFR:822 would apply to the lease if the AVFs could be impacted.

Mining activities may have an impact on the recreational use of Little Yampa Canyon. Sights and sounds from the mining operation could diminish the high quality recreational experience of float-boaters and others using the Yampa River and adjacent area.

Two FERC withdrawals occur within the tract for the unlicensed proposed Juniper Reservoir project. The high waterline of the reservoir would inundate Horse Gulch, Sand Spring Gulch, and Fuhr Gulch. This surface effect would preclude very little coal development, since the inundated areas are nearly encompassed by the floodplains. However, the extent of lateral movement of water into adjacent bedrock from the reservoir cannot be predicted; consequently, potential impacts to coal mining cannot be determined at this time.

In an effort to lessen cumulative impacts of simultaneously leasing adjacent tracts containing mule deer, antelope, and sage grouse reproduction areas, mitigation has been committed in the form of a special lease stipulation. The mitigation will reduce population declines to an acceptable level.

The tract does not have enough reserves to justify the capital outlay for a large surface mine. Approximately 1,243 acres would be disturbed to recover approximately 7 million tons of coal (figures do not reflect those precluded by floodplains).

SUMMARY OF INDIVIDUAL TRACTS

These two items, combined with floodplains, withdrawals, and increased costs for reclamation could make the tract uneconomical in a competitive market.

Short-term impacts of mining this tract could include:

1. The production of 7 million tons of Federal coal
2. Change in use of 4,117 acres from livestock/wildlife grazing and farmland to coal development
3. Creation of 40 jobs during construction and 50 jobs during production
4. Generation of additional revenue of \$1,600,000 in ad valorem taxes, severance taxes, and Federal royalties

5. The loss of 574 animal unit months of grazing annually

Long-term impacts predicted include the following:

1. Approximately 1.25 million tons of coal reserves would be unrecoverable with present technology.
2. The tract would be returned to present land use management.
3. Social and economic impacts would be short-lived; communities' capacities to deal with larger populations would be enhanced in the long term.
4. Reclamation requiring a return of 1,243 disturbed acres to a premining condition would offset any impacts to long-term productivity on visual resources.

APPENDIX 3

ECONOMICS DATA

METHODS OF ANALYSIS

An outline of the analytical method used in assessing economics impacts is presented here, but a step-by-step description would be too voluminous. Further information can be obtained by contacting BLM's Craig District Office.

Employment, Income, and Population

Analysis of these basic structural elements was done using an economic base model in Colorado developed by Mountain West Research and utilizing input-output models in Wyoming developed by Colorado State University. References describing these models are included in the Bibliography (Mountain West Research-Southwest, Inc., undated; McKean and Weber 1981). It is believed that the models adequately portray these areas and that their results are sufficiently comparable.

Basic industry forecasts were developed independently by BLM and put into the models to provide baseline projections. The tracts were then added to the baseline, the models were rerun, and the differences in output were taken as the first estimate of impacts. However, no model is perfect, so some adjustments were necessary to make the results realistic. In Colorado, particularly, figures for some communities were adjusted when they failed to conform to the pattern of tracts by alternative.

Housing

Increases in numbers of households were estimated by applying individual county ratios of population per household from the 1980 Census to the population projections.

Agriculture

Losses of AUMs came from the Land Use section. Dollar values per AUM were derived from a study by Colorado State University (Cook, Taylor, and Bartlett 1980) and from 'Ranch Budgets for Southern Wyoming' (BLM 1982c, unpublished).

Losses from conversion of agricultural land to other uses were estimated on a worst-case basis by assuming all converted land to be cropland. Per acre values were derived from 1980 crop value statistics (Colorado Department of Agriculture 1981) and land use data presented in Chapter 3. Wyoming crop value figures were not obtained, so a Colorado average was used.

Coal

Average values per ton by county for Colorado were derived from state mining statistics (Colorado Division of Mines 1981; McKean and Weber 1983a and 1983b).

Recreation

Baseline projections of total hunter days by species were derived from current state statistics (Colorado Division of Wildlife 1982; Wyoming Department of Game and Fish 1982), discussions with Division of Wildlife analysts, and Wyoming recreation plans (Wyoming Recreation Commission, undated) and were projected on a per capita basis by county. Impacts of animal population losses on hunting were estimated by using ratios of animals harvested to animal populations and hunter days per animal harvested (same references as above). Wyoming estimates of expenditures per hunter day (Wyoming Department of Game and Fish 1982) were used to evaluate impacts in both states because the only recent figures available in Colorado appear to contain some atypical results.

Local Government Finances

Estimates of mine property tax payments were based on methods, rates, and mill levies supplied by county assessors. Mine investment costs were estimated by using a formula described in the first Green River - Hams Fork EIS (BLM 1980). Tax rates and distribution formulas for severance taxes and Federal royalties were obtained from various Colorado state agencies and the Wyoming Taxpayers' Association.

ECONOMICS DATA

Community bonding capacities were projected on a per capita basis, using per capita assessed valuations and bonding limits given in Chapter 3. Bonding limits were also applied to Colorado home rule cities to serve as a proxy for voter resistance. Because school district assessed valuations are often high as a result of rural mine properties, school district bonding limits were applied to the increases in community assessed valuations within the districts.

Present capacities of most community facilities and school districts were obtained directly from the jurisdictions. Some data were acquired from the Wyoming Department of Education and estimated from the Wyoming recreation plan (Wyoming Recreation Commission, undated).

Standards for required capacities were assembled from various sources. Data gaps permitted only five to be estimated directly. Those five standards are (per 1,000 population): hospital beds - 1.75; water system - 0.2 million gallons per day (mgd); sewer system - 0.12 mgd; parks - 6.2 acres; and school classroom space - 23,000 square feet. Unit cost factors applied to the difference between requirements and present capacity were: hospital beds - \$95,000; water system (mgd) - \$8,100,000; sewer system (mgd) - \$6,100,000; parks (acre) - \$84,000; and schools (square foot) - \$95. To allow for the myriad other facilities, a total of \$230,000 per 1,000 population was added to the community totals. This figure was derived from a composite of standards and cost factors for other types of facilities.

BONDING CAPACITY AND REQUIREMENTS

Local government revenues and costs are divided into two types: operating and capital. Operating revenues and costs are those that are received and paid weekly, monthly, or annually. They include property taxes, water and sewer service fees, salaries, maintenance expenses, and similar items. Capital revenues and costs are those connected with major land acquisition and construction projects for improvements to water and sewer systems, parks, roads, etc. Revenues for capital projects are obtained from bond issues or Federal and state loans and grants. Bonding capacity, as used here, refers to the legal limit on the dollar amount of general obligation bonds that a local government may have outstanding and represents the maximum amount of capital funding that can be raised from

local sources. The state government imposes the limit. General obligation bonds are those that are repaid from the jurisdiction's general treasury and have no special revenue source, such as water and sewer charges.

Table A3-1 compares the capabilities of (1) impacted communities and school districts to finance capital improvements from their own resources (bonding capacity) with (2) the capital improvements requirements that would be brought about by the No Action and leasing alternatives. Capability to finance these improvements from their own resources is the most valid measure to use because the availability of sufficient impact aid from Federal and state sources cannot be assured. The amount of funds available for impact aid varies from year to year and is almost never sufficient for the needs of all of the communities and school districts that are competing for a share of it.

The only way in which major capital improvements can be funded from a community's or school district's own resources is through bond issues. Both Colorado and Wyoming state legislatures have set legal limits on the dollar amount of bonded indebtedness that local governments may have. Those limits are based on the total assessed valuation of the community or school district. The percent limits are given in a footnote to table 3-28 in Chapter 3. From that gross bonding capacity is subtracted the bonds (general obligation) that are currently outstanding to derive the net, or remaining, bonding capacity that has been used in this analysis. As the community or school district grows or declines, its assessed valuation increases or decreases. These changes are reflected in the bonding capacity figures shown under the No Action alternative and the additions to bonding capacity shown for each leasing alternative in the table.

Requirements for capital improvements increase as population increases, and the requirements given in table A3-1 are based on the population projections in table 4-26 in Chapter 4. Average factors are used to calculate the physical capacity for each type of facility (hospital beds, water system, etc.) that would be needed to support the projected population. The present capacity is subtracted from that requirement, and any shortfall is multiplied by a cost factor to determine the dollar requirement. The capital improvements requirements are the sums of these costs calculated for each community and school district under each alternative. Details on the factors and facilities included are given earlier in this appendix.

TABLE A3-1

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Craig							
Remaining bonding capacity from No Action Alternative	\$ 0	\$ 0	\$ 0	\$ 0	\$5,570	\$6,040	\$6,040
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		30	120	120	110	360	360
High Alternative		150	360	360	470	990	990
Maximum Alternative		380	750	750	1,100	2,190	2,190
Dinosaur							
Remaining bonding capacity from No Action Alternative	58	41	43	44	0	0	0
Additions to bonding capacity from:							
Low Alternative		2	10	10	0	0	0
Moderate Alternative		2	10	10	0	0	0
High Alternative		2	10	10	0	0	0
Maximum Alternative		2	10	10	0	0	0
Moffat County School District							
Remaining bonding capacity from No Action Alternative	50,500	51,460	51,760	51,760	470	1,410	1,540
Additions to bonding capacity from:							
Low Alternative		5	15	15	70	130	200
Moderate Alternative		50	260	260	200	940	940
High Alternative		300	730	730	1,000	2,410	2,410
Maximum Alternative		760	1,510	1,510	2,410	4,890	4,890
Meeker							
Remaining bonding capacity from No Action Alternative	710	1,700	2,310	2,000	2,700	5,790	5,790
Additions to bonding capacity from:							
Low Alternative		10	10	10	10	10	10
Moderate Alternative		80	130	130	230	760	760
High Alternative		80	140	140	240	840	840
Maximum Alternative		100	170	170	240	1,070	1,070

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Meeker School District							
Remaining bonding capacity from No Action Alternative	\$5,980	\$7,970	\$9,180	\$8,570	\$2,750	\$6,230	\$6,230
Additions to bonding capacity from:							
Low Alternative		20	20	20	70	70	70
Moderate Alternative		150	250	250	470	670	670
High Alternative		170	290	290	470	800	800
Maximum Alternative		190	340	340	540	940	940
Rangely							
Remaining bonding capacity from No Action Alternative	900	1,030	1,300	1,280	90	280	280
Additions to bonding capacity from:							
Low Alternative		90	180	180	60	120	120
Moderate Alternative		90	180	180	60	120	120
High Alternative		90	180	180	60	120	120
Maximum Alternative		90	180	180	60	120	120
Rangely School District							
Remaining bonding capacity from No Action Alternative	60,710	60,980	61,520	61,480	0	670	670
Additions to bonding capacity from:							
Low Alternative		180	350	350	0	800	800
Moderate Alternative		180	350	350	0	800	800
High Alternative		180	350	350	0	800	800
Maximum Alternative		180	350	350	0	800	800
Hayden							
Remaining bonding capacity from No Action Alternative	0	0	0	0	1,130	1,140	1,250
Additions to bonding capacity from:							
Low Alternative		2	2	2	0	90	0
Moderate Alternative		5	5	5	0	90	10
High Alternative		30	50	60	120	210	230
Maximum Alternative		50	80	90	220	330	340

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Hayden School District							
Remaining bonding capacity from No Action Alternative	\$10,210	\$10,450	\$10,470	\$10,530	\$ 0	\$ 0	\$ 0
Additions to bonding capacity from:							
Low Alternative		5	5	5	0	0	0
Moderate Alternative		10	15	15	0	0	0
High Alternative		60	90	120	0	0	130
Maximum Alternative		110	150	180	0	0	340
Steamboat Springs							
Remaining bonding capacity from No Action Alternative	2,420	3,660	3,970	4,720	1,760	1,850	2,240
Additions to bonding capacity from:							
Low Alternative		30	20	20	10	0	0
Moderate Alternative		30	20	20	10	0	0
High Alternative		240	390	690	60	300	470
Maximum Alternative		270	450	750	170	310	490
Steamboat Springs School District							
Remaining bonding capacity from No Action Alternative	10,490	12,960	13,580	15,080	9,040	9,650	11,120
Additions to bonding capacity from:							
Low Alternative		50	30	30	70	70	0
Moderate Alternative		50	30	30	70	70	0
High Alternative		470	790	1,380	470	740	1,270
Maximum Alternative		540	910	1,500	540	870	1,340
Oak Creek							
Remaining bonding capacity from No Action Alternative	50	50	50	50	250	250	250
Additions to bonding capacity from:							
Low Alternative		1	1	1	0	0	0
Moderate Alternative		1	1	1	0	0	0
High Alternative		5	10	40	0	10	230
Maximum Alternative		5	10	40	0	10	230

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Yampa							
Remaining bonding capacity from No Action Alternative	\$ 120	\$ 120	\$ 120	\$ 120	\$ 0	\$ 0	\$ 0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		0	0	0	0	0	0
High Alternative		0	1	5	0	0	0
Maximum Alternative		0	1	5	0	0	0
South Routt School District							
Remaining bonding capacity from No Action Alternative	4,950	4,920	4,930	4,940	800	800	870
Additions to bonding capacity from:							
Low Alternative		2	2	2	0	0	0
Moderate Alternative		2	2	2	0	0	0
High Alternative		10	30	90	70	130	400
Maximum Alternative		10	30	90	70	130	470
Baggs							
Remaining bonding capacity from No Action Alternative	30	30	40	40	0	0	10
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		0	0	0	0	0	0
High Alternative		0	0	0	0	0	0
Maximum Alternative		2	10	10	10	40	40
Rawlins							
Remaining bonding capacity from No Action Alternative	0	0	0	0	0	60	390
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		20	300	300	70	980	1,310
High Alternative		90	370	370	250	1,170	1,500
Maximum Alternative		120	550	550	350	1,720	2,050

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Rawlins School District							
Remaining bonding capacity from No Action Alternative	\$30,760	\$30,760	\$30,810	\$31,090	\$ 0	\$ 0	\$ 0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		60	760	760	0	0	0
High Alternative		210	920	920	0	0	0
Maximum Alternative		300	1,410	1,410	0	0	0
Diamondville							
Remaining bonding capacity from No Action Alternative	60	90	100	100	650	770	870
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		0	1	1	0	0	0
High Alternative		0	1	1	0	0	0
Maximum Alternative		0	1	1	0	0	0
Kemmerer							
Remaining bonding capacity from No Action Alternative	50	160	200	210	2,000	2,470	2,700
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		1	3	3	0	10	10
High Alternative		1	3	3	0	10	10
Maximum Alternative		1	3	3	0	10	10
Kemmerer School District							
Remaining bonding capacity from No Action Alternative	14,350	14,700	14,810	14,860	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		5	10	10	0	0	0
High Alternative		5	10	10	0	0	0
Maximum Alternative		5	10	10	0	0	0

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
<u>Green River</u>							
Remaining bonding capacity from No Action Alternative	\$ 1,110	\$ 1,170	\$ 1,180	\$ 1,190	\$ 180	\$ 200	\$ 240
Additions to bonding capacity from:							
Low Alternative		3	5	5	10	20	20
Moderate Alternative		3	5	5	10	20	20
High Alternative		10	20	40	30	70	120
Maximum Alternative		10	20	40	30	70	120
<u>Green River School District</u>							
Remaining bonding capacity from No Action Alternative	32,110	32,250	32,260	32,290	0	0	0
Additions to bonding capacity from:							
Low Alternative		5	10	10	0	0	0
Moderate Alternative		5	10	10	0	0	0
High Alternative		20	60	90	0	0	0
Maximum Alternative		20	60	90	0	0	0
<u>Rock Springs</u>							
Remaining bonding capacity from No Action Alternative	1,750	1,950	1,960	1,980	500	520	580
Additions to bonding capacity from:							
Low Alternative		30	50	50	70	130	130
Moderate Alternative		30	50	50	70	130	130
High Alternative		70	180	310	180	460	780
Maximum Alternative		70	180	310	180	460	780
<u>South Superior</u>							
Remaining bonding capacity from No Action Alternative	15	15	15	15	10	10	10
Additions to bonding capacity from:							
Low Alternative		1	1	1	10	10	10
Moderate Alternative		1	1	1	10	10	10
High Alternative		1	3	5	10	170	330
Maximum Alternative		1	3	5	10	170	330

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
Rock Springs School District							
Remaining bonding capacity							
from No Action Alternative	\$49,870	\$50,360	\$50,390	\$50,440	0	0	0
Additions to bonding capacity from:							
Low Alternative		70	130	130	0	0	0
Moderate Alternative		70	130	130	0	0	0
High Alternative		180	460	790	0	1,540	4,490
Maximum Alternative		180	460	790	0	1,540	4,490
Evanston							
Remaining bonding capacity							
from No Action Alternative	1,650	1,510	1,530	1,490	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		10	30	30	0	0	0
High Alternative		10	30	30	0	0	0
Maximum Alternative		10	30	30	0	0	0
Evanston School District							
Remaining bonding capacity							
from No Action Alternative	\$38,590	\$38,240	\$38,280	\$38,190	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		30	70	70	0	0	0
High Alternative		30	70	70	0	0	0
Maximum Alternative		30	70	70	0	0	0
Lyman							
Remaining bonding capacity							
from No Action Alternative	50	40	40	30	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		1	2	2	0	0	0
High Alternative		1	2	2	0	0	0
Maximum Alternative		1	2	2	0	0	0

TABLE A3-1
(Continued)

IMPACTS ON BONDING CAPACITY AND CAPITAL IMPROVEMENTS
(thousand dollars)

	Bonding Capacity				Capital Improvements Requirements		
	1983	1992	1995	2000	1992	1995	2000
<u>Lyman School District</u>							
Remaining bonding capacity from No Action Alternative	\$3,320	\$3,290	\$3,290	\$3,280	\$ 0	\$ 0	\$ 0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		1	5	5	0	0	0
High Alternative		1	5	5	0	0	0
Maximum Alternative		1	5	5	0	0	0
<u>Mountain View</u>							
Remaining bonding capacity from No Action Alternative	60	60	60	60	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		1	1	1	0	0	0
High Alternative		1	1	1	0	0	0
Maximum Alternative		1	1	1	0	0	0
<u>Mountain View School District</u>							
Remaining bonding capacity from No Action Alternative	580	570	570	570	0	0	0
Additions to bonding capacity from:							
Low Alternative		0	0	0	0	0	0
Moderate Alternative		2	3	3	0	0	0
High Alternative		2	3	3	0	0	0
Maximum Alternative		2	3	3	0	0	0

APPENDIX 4

VEGETATION ANALYSIS METHODOLOGY

Origin of Baseline Figures

Numbers of acres of each vegetation type for the region were taken from the Southcentral and Southwest Wyoming Coal Environmental Statements, and the Williams Fork, Meeker, and Rangely Planning Unit documents. Baseline acres of disturb-

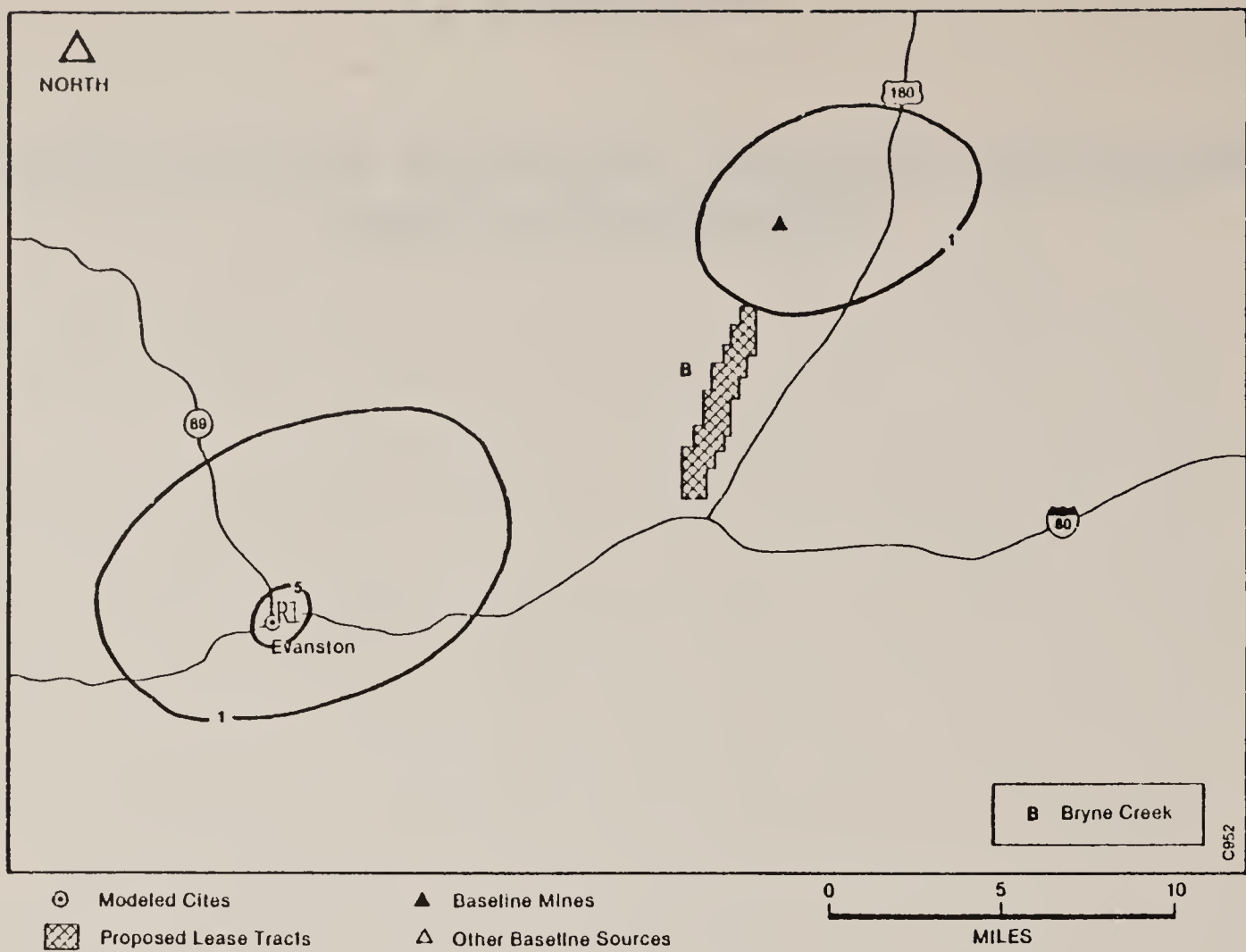
ance were calculated on the basis of the percentage values assigned to each type in the region.

Origin of Maximum Alternative Figures

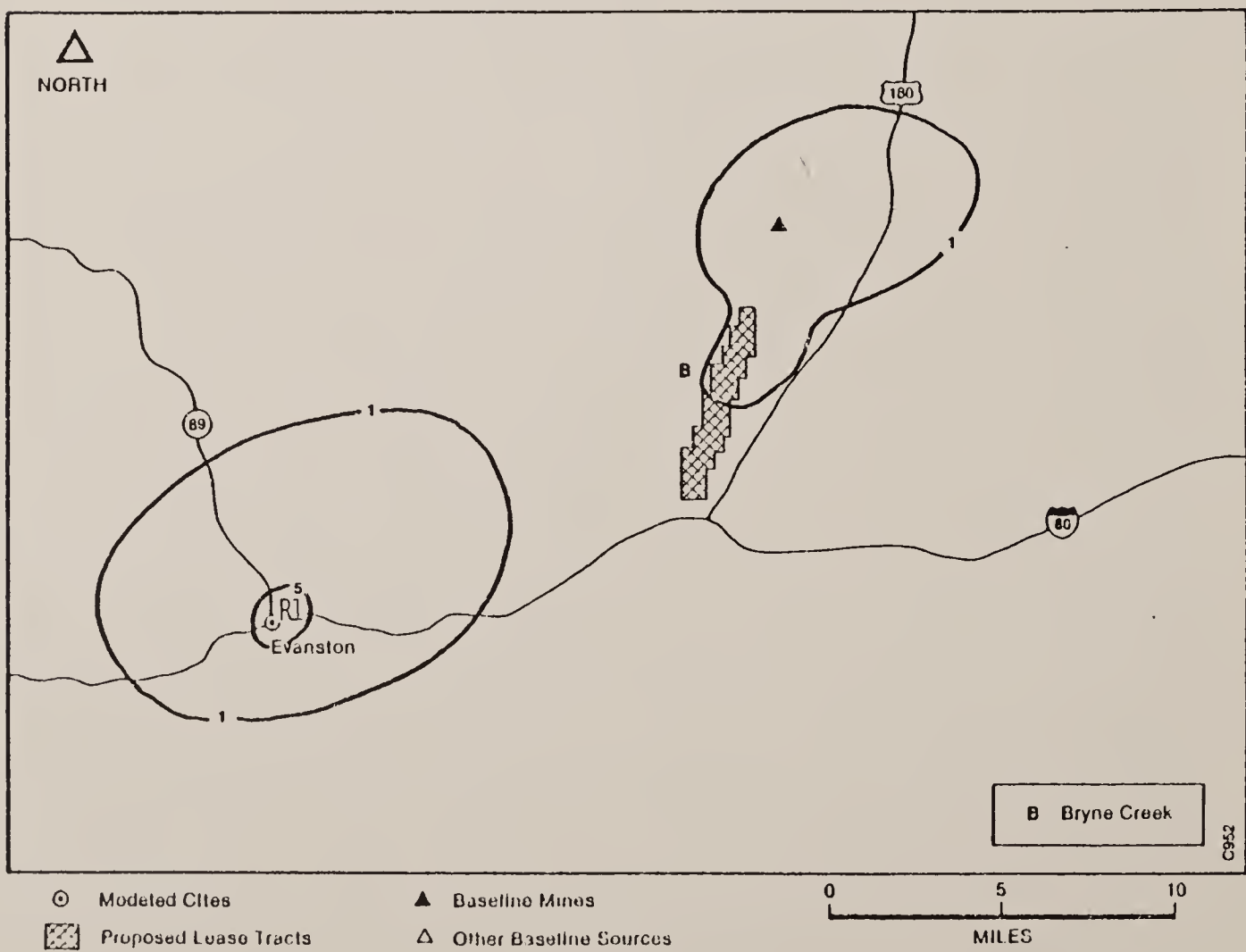
Numbers of acres of each vegetation type disturbed were taken from individual tract profiles of the site specific analyses for the 24 tracts.

APPENDIX 5

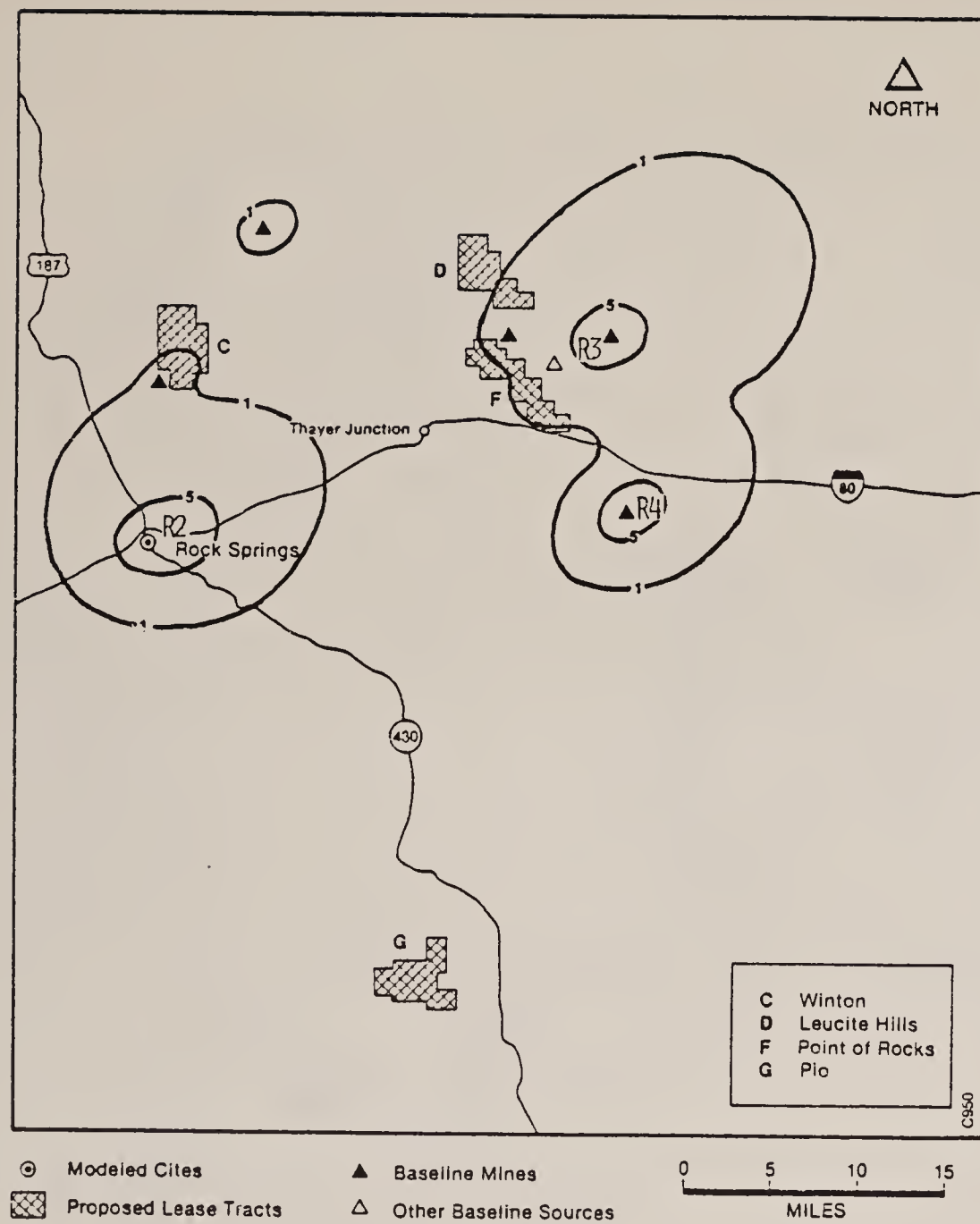
PREDICTED ANNUAL AVERAGE AIR POLLUTANT CONCENTRATIONS



No Action Alternative
1995 and 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)



Maximum Development Alternative
2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)



No Action Alternative
1995 and 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

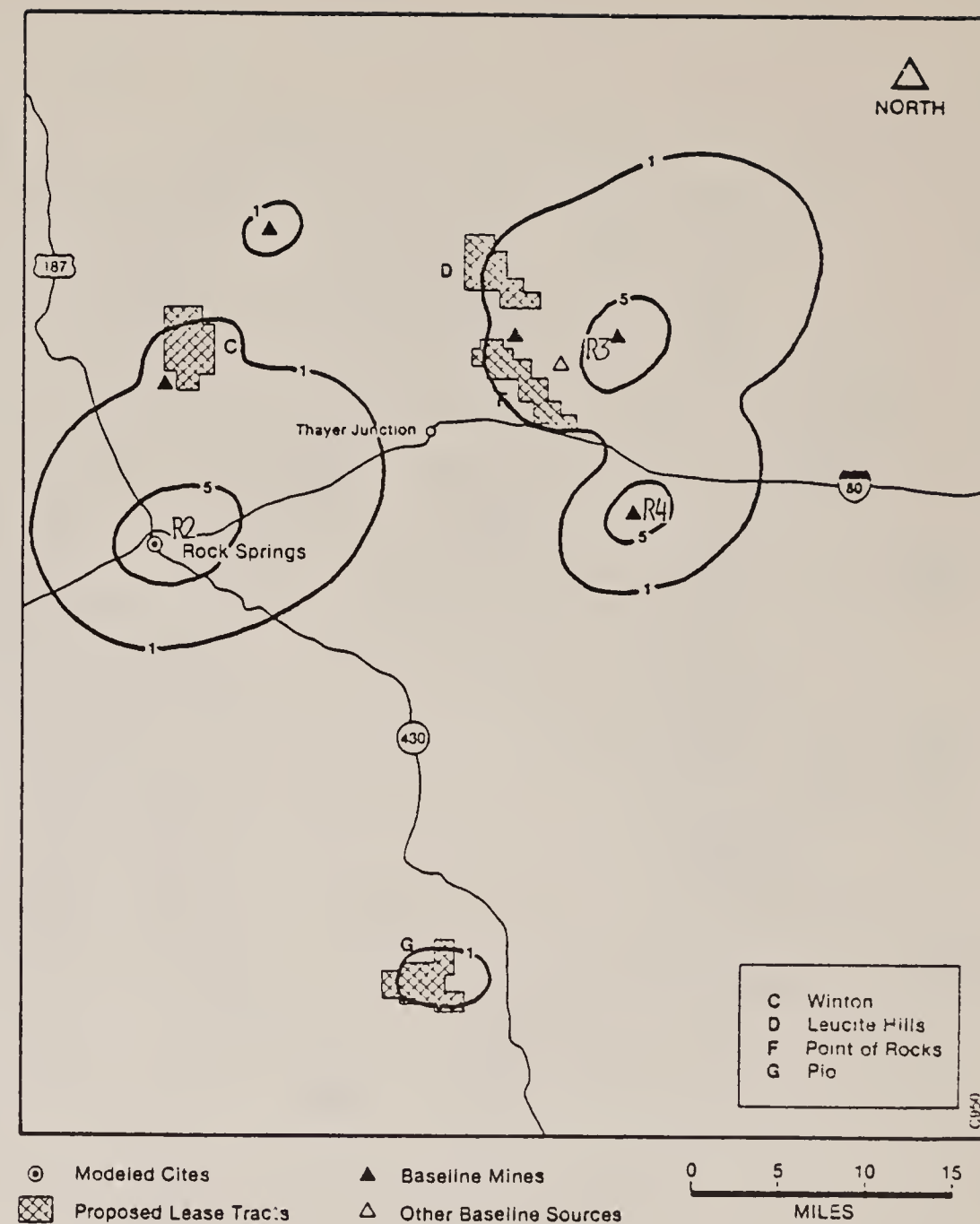
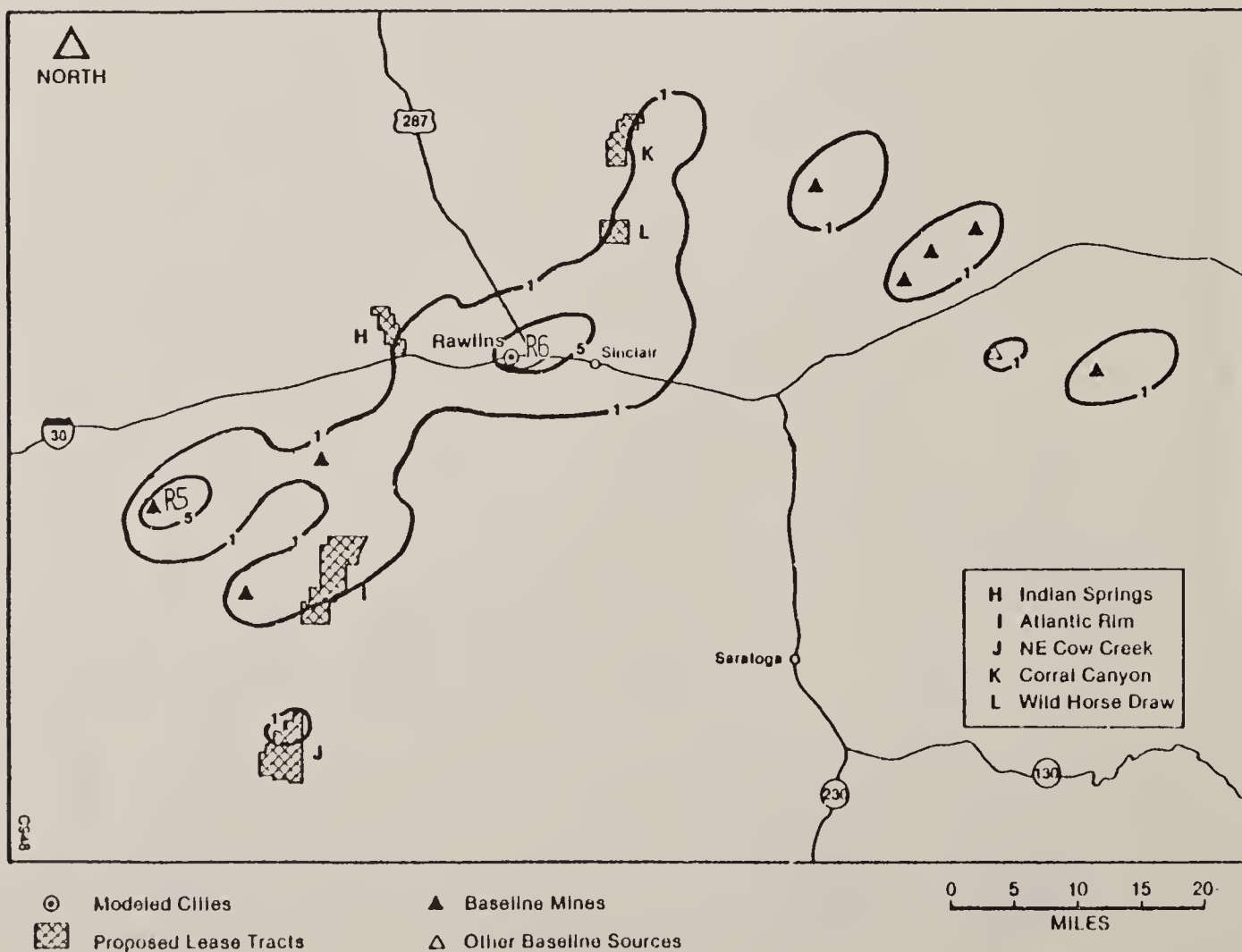
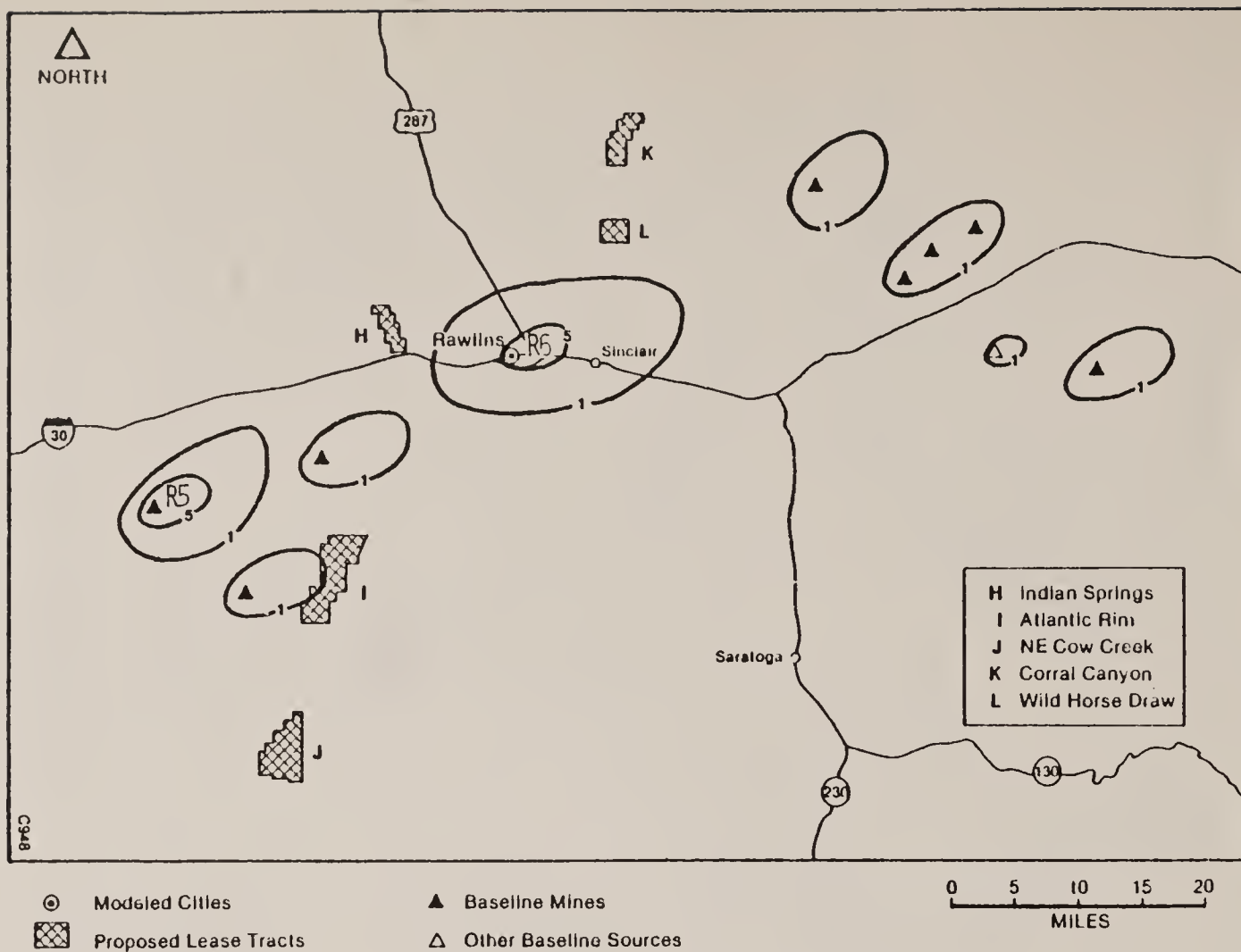
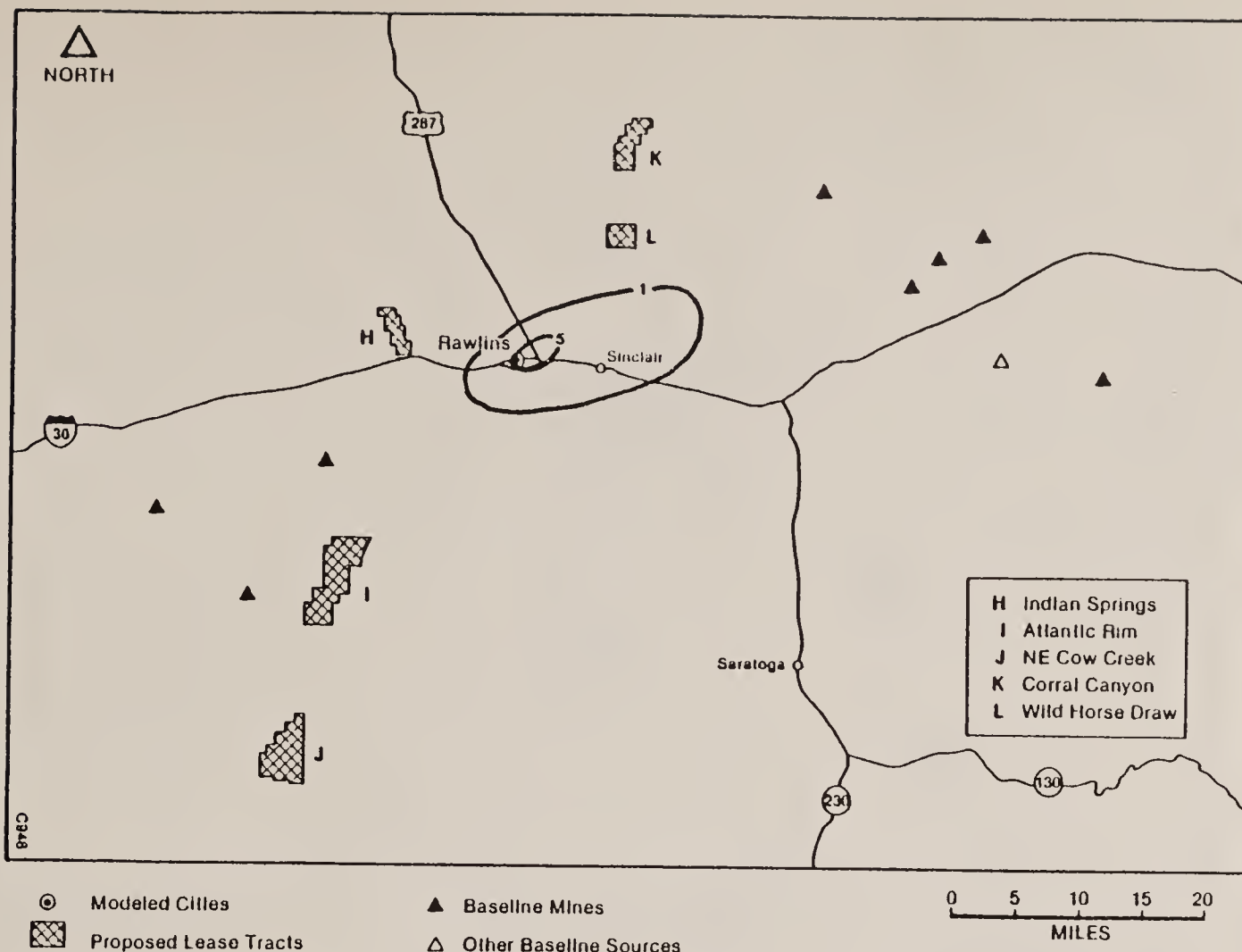


FIGURE A5-2

Maximum Development Alternative
2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)





No Action Alternative
1995 and 2000 Annual Average Sulfur Dioxide Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

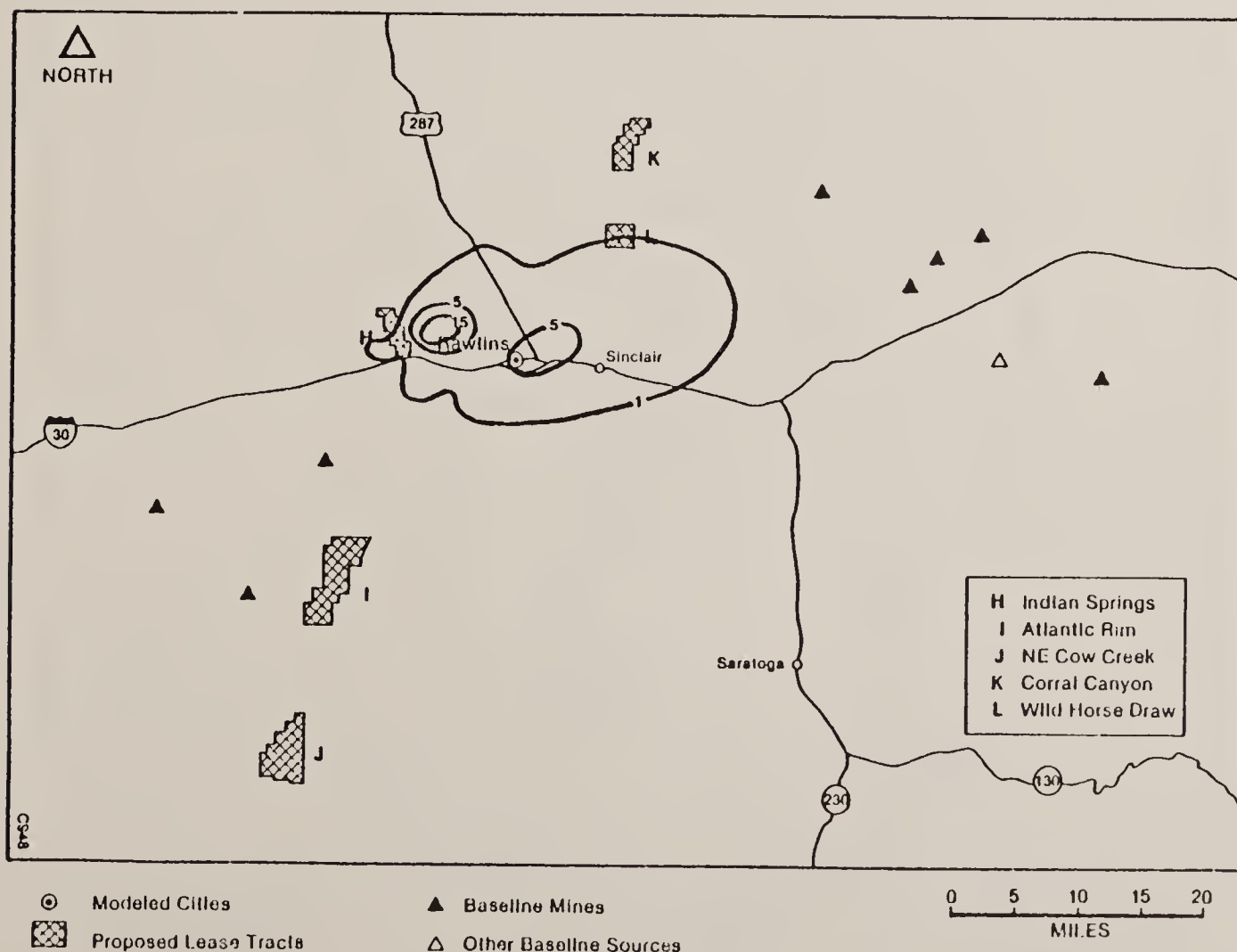
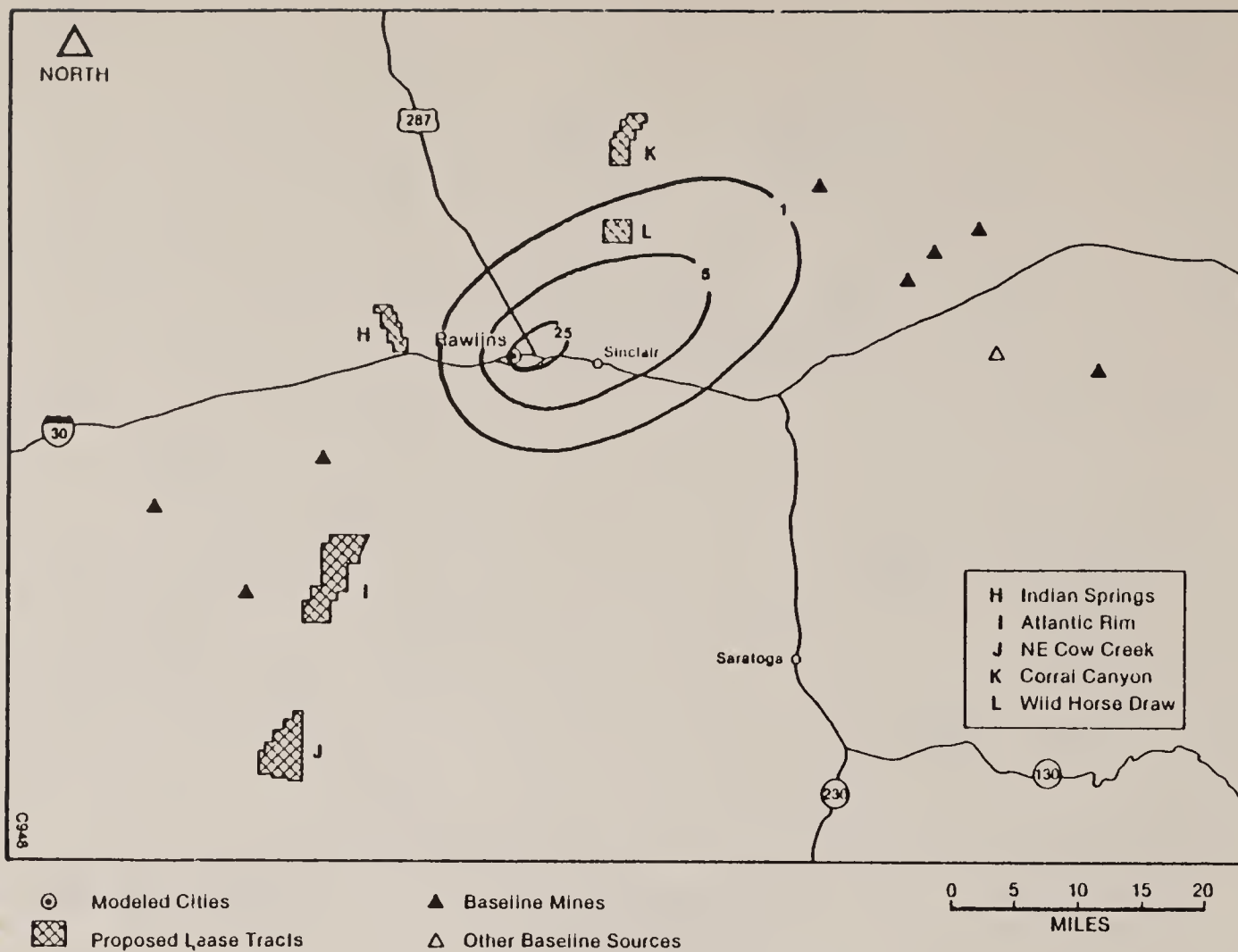


FIGURE A5-4
Maximum Development Alternative
1995 and 2000 Annual Average Sulfur Dioxide Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)



No Action Alternative
1995 and 2000 Annual Average Nitrogen Oxides Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

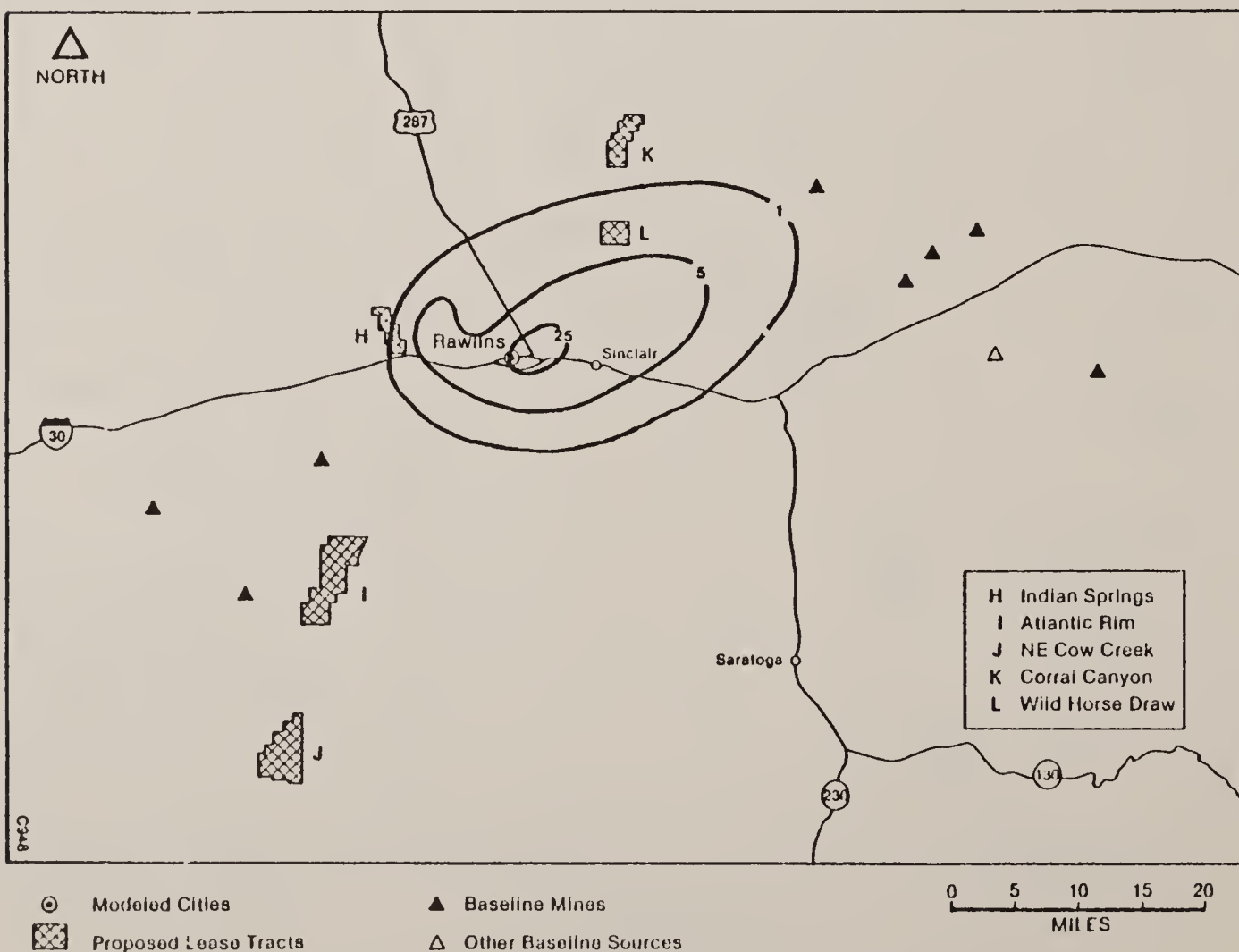
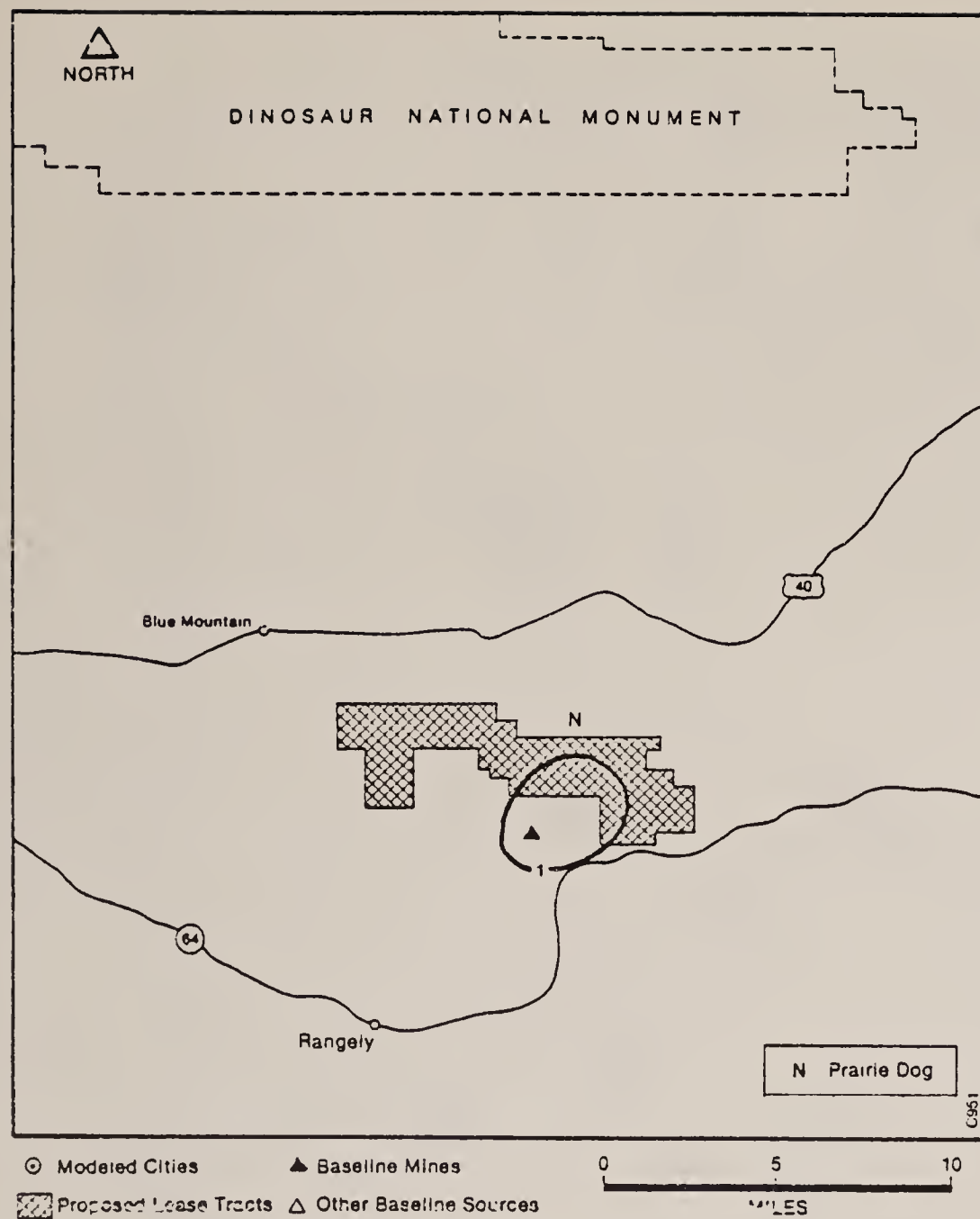
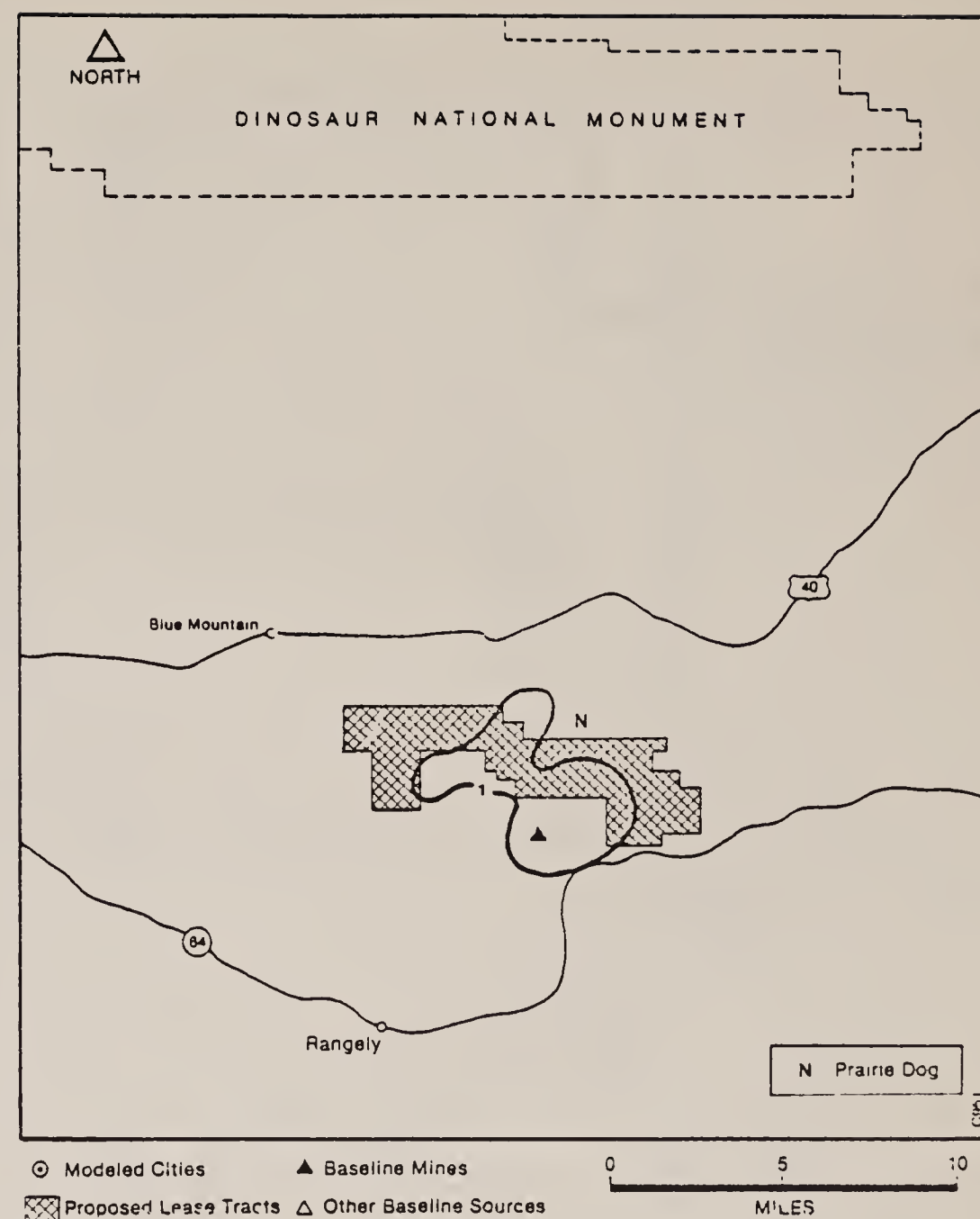


FIGURE A5-5
Maximum Development Alternative
1995 and 2000 Annual Average Nitrogen Oxides Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

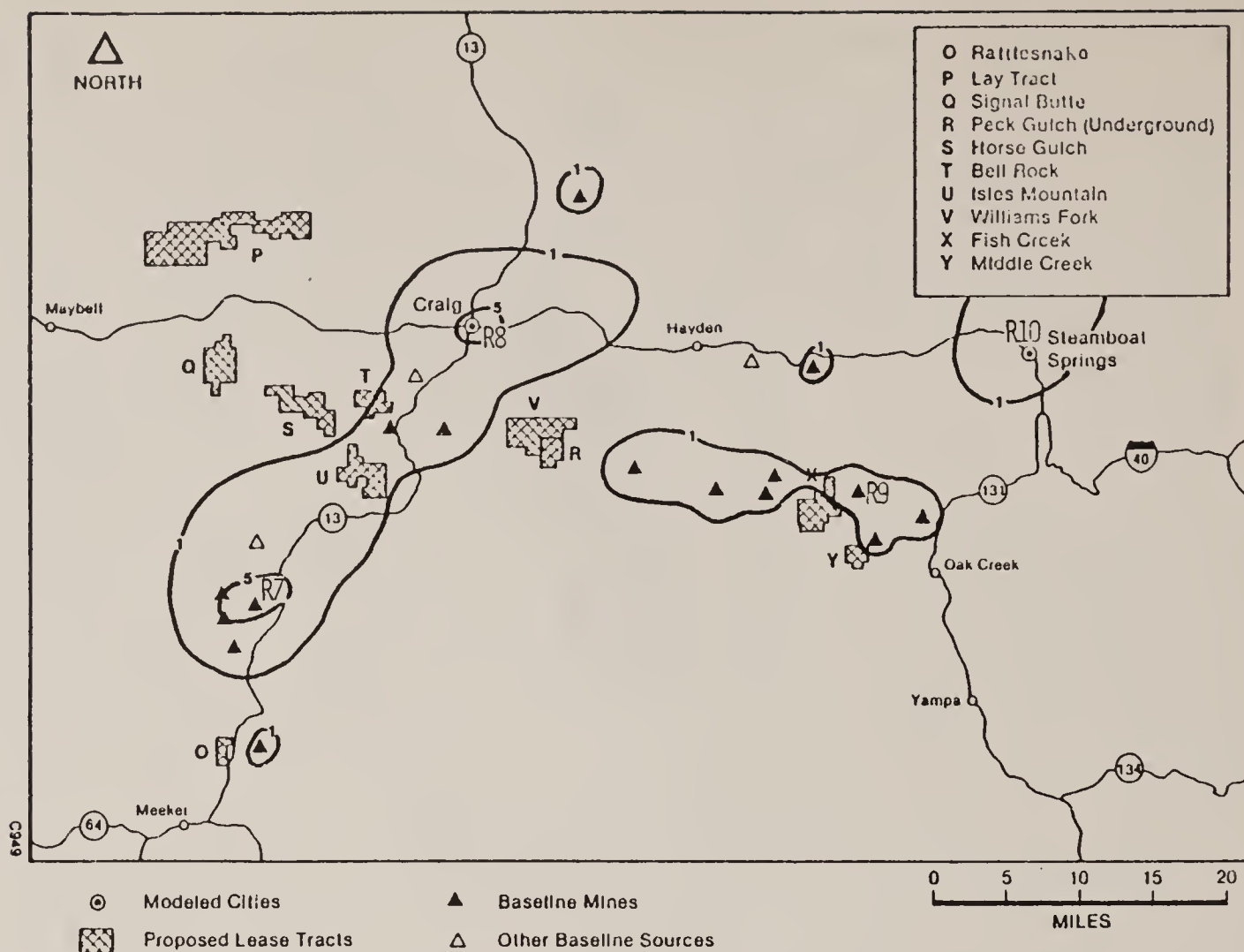


No Action Alternative
 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
 (Predicted Increase Above Background)



Maximum Development Alternative
 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
 (Predicted Increase Above Background)

FIGURE A5-6



No Action Alternative
1995 and 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

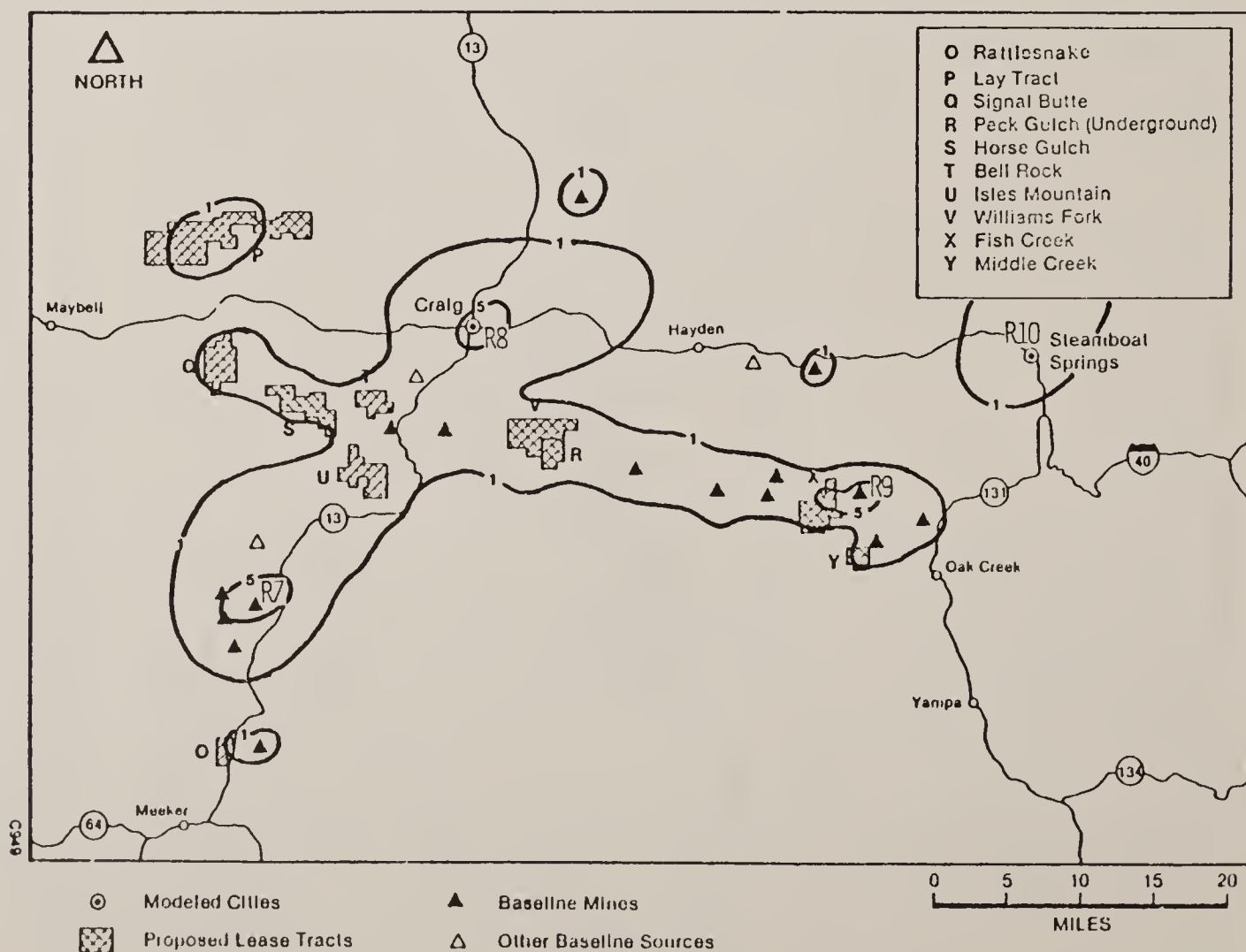


FIGURE A5-7
Maximum Development Alternative
1995 and 2000 Annual Average Total Suspended Particulate Matter Concentrations ($\mu\text{g}/\text{m}^3$)
(Predicted Increase Above Background)

TABLE A5-1

PROJECT OPERATION AND EMISSION ASSUMPTIONS FOR PROPOSED LEASE TRACTS*

Tract Name	Annual Prod. Rate	1995 Emissions TSP	2000 Emissions TSP	EML Emissions TSP
<u>Northwest Colorado</u>				
Prairie Dog	1.0	183	183	183
Rattlesnake	0.9	292	292	292
Lay Creek	1.7	1,714	1,318	2,246
Signal Butte	2.0	1,234	1,286	502
Peck Gulch	1.2	513	513	513
Horse Gulch	0.5	987	1,079	1,147
Bell Rock	1.0	712	712	712
Hes Mountain	1.7	1,032	1,032	1,219
Williams Fork	1.3	2,605	2,638	2,908
Little Middle Creek**	3.3	-	-	-
Fish Creek	1.0	714	248	248
Middle Creek	0.1	19	19	19
<u>South-Central Wyoming</u>				
Indian Springs	1.2	653	653	653
Atlantic Rim	5.4	6,132	6,691	5,899
NE Cow Creek	1.8	458	458	458
Corral Canyon	2.4	3,671	3,547	4,106
Wild Horse Draw	1.7	4,286	4,506	4,506
<u>Southwest Wyoming</u>				
Tract 98**	0.5	-	-	-
Byrne Creek	0.5	525	568	741
Winton	2.0	184	332	332
Leucite Hills	0.5	964	1,033	1,158
Deadman**	0.3	-	-	-
Point of Rocks	0.5	602	516	528
Pio	0.5	700	855	809

SOURCE: Radlan Corporation, 1983b.

* Annual production rate in million tons per year, emission rate in tons per year.

** Maintenance tract - emission impacts included in background estimates.

TABLE A5-2

PREDICTED "WORST-CASE" MAXIMUM TRACT SPECIFIC TOTAL SUSPENDED
PARTICULATE CONCENTRATIONS*

Tract	Back- ground	24-Hour Concentration						Back- ground	Annual Concentration					
		Additional			Total				Additional			Total		
		1995	2000	EML	1995	2000	EML		1995	2000	EML	1995	2000	EML
<u>Northwest Colorado</u>														
Prairie Dog	80	26	26	26	106	106	106	18	9	9	9	27	27	27
Rattlesnake	80	61	61	61	141	141	141	18	3	3	3	21	21	21
Lay Creek	80	18	6	11	98	86	91	20	6	8	9	26	28	29
Signal Butte	80	36	20	5	116	100	85	20	4	3	2	24	23	22
Peck Gulch	80	74	74	74	154	154	154	20	13	13	13	33	33	33
Horse Gulch	80	10	14	19	90	94	99	20	6	6	5	26	26	25
Bell Rock	80	28	28	28	108	108	108	20	16	16	16	36	36	36
Hies Mountain	80	24	24	23	104	104	103	20	6	6	6	26	26	26
Williams Fork	80	16	19	15	96	99	95	20	6	5	5	26	25	25
Little Middle Creek**	90	-	-	-	90	90	90	21	-	-	-	21	21	21
Fish Creek	90	65	10	10	155	100	100	21	20	19	19	41	40	40
Middle Creek	90	4	4	4	94	94	94	21	0	0	0	21	21	21
<u>South-Central Wyoming</u>														
Indian Springs	45	30	30	30	75	75	75	34	5	5	5	39	39	39
Atlantic Rim	45	43	63	43	88	108	88	34	5	15	3	39	49	37
NE Cow Creek	45	12	12	12	57	57	57	34	1	1	1	35	35	35
Corral Canyon	45	62	62	72	107	107	117	34	13	14	15	47	48	49
Wild Horse Draw	45	36	37	37	81	82	82	34	11	10	12	45	44	46
<u>Southwest Wyoming</u>														
Tract 98**	45	-	-	-	45	45	45	17	-	-	-	17	17	17
Byrne Creek	45	21	12	8	66	57	53	17	3	3	5	20	20	22
Winton	45	13	17	17	58	62	62	38	2	5	5	40	43	43
Leucite Hills	45	102	96	95	147	141	140	35	9	9	8	44	44	43
Deadman**	45	-	-	-	45	45	45	35	-	-	-	35	35	35
Point of Rocks	45	11	36	15	56	81	60	35	3	4	5	38	39	40
Plo	45	48	44	24	93	89	69	38	9	5	4	47	43	42

SOURCE: Radlan Corporation, 1983a

NOTE: Underlined values indicate potential violation of Ambient Air Quality Standards (secondary 24-hour 150 micrograms per cubic meter).

* Concentrations in micrograms per cubic meter.

** Maintenance tract - concentration impacts included in background estimates.

APPENDIX 6

MITIGATION REQUIREMENTS

Lessees will be required to develop their Federal leases in compliance with all applicable Federal, state, and local laws and regulations. These are considered to be in-place constraints to a lessee's activities. Therefore, enforceable statutes, performance standards, and other license requirements are considered part of proposed Federal actions under all alternatives and are applicable to all coal tracts.

Those Federal laws which provide overall protection of the environment include the National Environmental Policy Act of 1969, the Federal Land Policy and Management Act of 1976, and the Surface Mining Control and Reclamation Act of 1977. Additional Federal and state laws and their implementing regulations provide for protection of specific resources. Air quality is regulated by the Clean Air Act (as amended) as well as by various Colorado and Wyoming laws and regulations. The regulatory requirements of the Colorado Mined Land Reclamation Board and the Wyoming Department of Environmental Quality provide extensive protection of natural resources from mining impacts, including geology, topography, soils, vegetation, wildlife, and water resources. Wildlife is further governed by the Endangered Species Act of 1973, the Fish and Wildlife Coordination Act of 1934, the Migratory Bird Act, the Bald Eagle Protection Act of 1969, and the Wild Free-Roaming Horse and Burro Act.

Water resources are specifically addressed by the Federal Water Pollution Control Act of 1972, the Clean Water Act of 1977, the Safe Drinking Water Act of 1977, and the Colorado River Basin Salinity Control Act. Cultural and paleontological resources are protected through the Antiquities Act of 1906, the Historic Sites Act of 1935, the National Historic Preservation Act of 1966, the Archaeological and Historic Data Conservation Act of 1974, the Archaeological Resources Protection Act of 1979, and the Colorado Antiquities Act of 1973. Mitigation of economic and social impacts is the responsibility of State and local governments. Large revenues to that end are provided by Section 35 of the Mineral Leasing Act of 1920.

In addition, through the land use planning and activity planning processes, BLM has considered the practicable means to avoid or minimize environmental harm resulting from the alternative leasing actions, above and beyond those standards which are already required by existing regulations or laws. The following mitigation measures are considered to be real, committed, and legally enforceable. The

general mitigation measures apply to all tracts under all leasing alternatives. The tract-specific measures apply only to particular tracts and the alternatives in which they occur. Additional mitigation measures, if warranted, may be identified as a result of the EIS process.

All Colorado and Wyoming Tracts

1. Cultural resources:

a. Before undertaking any activities that may disturb the surface of the leased lands, the lessee shall conduct a cultural resource intensive field inventory in a manner specified by the authorized officer of BLM on portions of the mining plan area and adjacent areas, or exploration plan area, that may be adversely affected by lease related activities and which were not previously inventoried at such a level of intensity. The inventory shall be conducted by a qualified professional cultural resource specialist (i.e., archeologist, historian, or historical architect, as appropriate) approved by the authorized officer of BLM, and a report of the inventory and recommendations for protecting any cultural resources identified shall be submitted to the Office of Surface Mining (OSM) and the authorized officer of BLM (or only to the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area). The lessee shall undertake measures, in accordance with instructions from OSM (or the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area), to protect cultural resources on the leased land. The lessee shall not commence the surface disturbing activities until permission to proceed is given by OSM (or the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area).

b. The lessee shall protect all known cultural resource properties within the lease area from lease related activities until the cultural resource mitigation measures can be implemented as part of an approved mining and reclamation plan or exploration plan.

c. The cost of conducting the inventory, preparing reports, and carrying out mitigation measures shall be borne by the lessee.

MITIGATION REQUIREMENTS

d. If cultural resources are discovered during operations under a lease, the lessee shall immediately bring them to the attention of OSM (or the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area), or the authorized officer of the surface managing agency if OSM or the BLM Authorized Officer, as appropriate, is not available. The lessee shall not disturb such resources except as may be subsequently authorized by OSM (or the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area). Within two (2) working days of notification, OSM (or the BLM Authorized Officer if activities are associated with coal exploration outside an approved mining permit area) will examine or have examined any cultural resources discovered and will determine if any action may be required to protect or preserve such discoveries. The cost of data recovery for cultural resources discovered during lease operations shall be borne by the surface managing agency unless otherwise specified by the authorized officer of BLM or of the surface managing agency (if different).

e. All cultural resources shall remain under the jurisdiction of the United States until ownership is determined under applicable law.

2. The lease is subject to valid existing rights. Any negotiations for relocation or displacement are between the lessee and the existing right holder, except such negotiations must be approved by the BLM Authorized Officer.

3. Paleontological resources:

a. Before undertaking any activities that may disturb the surface of any leased lands, the lessee shall contact the Bureau of Land Management to determine whether the authorized officer will require the lessee to conduct a paleontological appraisal of the mining plan and adjacent areas, or exploration plan areas, that may be adversely affected by lease related activities. If the authorized officer determines that one is necessary, the paleontological appraisal shall be conducted by a qualified paleontologist approved by the authorized officer of the surface managing agency, using the published literature and, where appropriate, field appraisals for determining the possible existence of larger and more conspicuous fossils of scientific significance. A report of the appraisal and recommendations for protecting any larger and more conspicuous fossils of significant scientific interest on any leased lands so identified shall be submitted to the authorized officer of the surface managing agency (BLM if the surface is privately owned). When necessary to protect and collect the larger and more conspicuous fossils of significant scientific interest on any leased lands, the lessee shall undertake the meas-

ures provided in the approval of the mining and reclamation plan or exploration plan.

b. The lessee shall not knowingly disturb, alter, destroy, or take any larger and more conspicuous fossils of significant scientific interest and shall protect all such fossils in conformance with the measures included in the approval of the mining and reclamation plan or exploration plan.

c. The lessee shall immediately bring any such fossils that might be altered or destroyed by his operation to the attention of OSM or the BLM AO, as appropriate. Operations may continue as long as the fossil specimen or specimens would not be seriously damaged or destroyed by the activity. OSM or the BLM AO, as appropriate, shall evaluate or have evaluated such discoveries brought to his attention and, within five (5) working days, shall notify the lessee what action shall be taken with respect to such discoveries.

d. All such fossils of significant scientific interest shall remain under the jurisdiction of the United States until ownership is determined under applicable law. Copies of all paleontological resource data generated as a result of any lease term requirements will be provided to OSM or the BLM AO, as appropriate.

e. The cost of any required salvage of such fossils shall be borne by the United States.

f. These conditions apply to all such fossils of significant scientific interest discovered within any lease whether discovered in the overburden, or coal seam or seams.

All Wyoming Tracts

1. The lessee will be required to monitor and inventory the lease area for establishment of potential black-footed ferret habitat (i.e. prairie dog towns) and, if any such habitat is found, to conduct ferret inventories, all in accordance with the guidelines below. In the event that ferret occurrence is identified, the lessee will be required to adhere to any suggested modifications in the mining operation provided by the Fish and Wildlife Service and the BLM.

The following Black-Footed Ferret Inventory Guidelines will be followed. Proposed developments such as coal lease lands, power plant sites, well fields, dam sites, and other major, block-type developments should be surveyed for prairie dogs before the project is approved. If prairie dogs are found on the proposed site, colonies should be mapped on topographic maps and each colony surveyed using recommended Black-Footed Ferret Survey Proce-

MITIGATION REQUIREMENTS

dures. Ferret searches should be scheduled as close to actual construction as is reasonable to minimize the possibility of missing ferrets that might move onto the area during the period between completion of surveys and the start of construction. Where project disturbance takes place over a long period of time, such as on a coal site, additional surveys for black-footed ferrets are recommended.

2. The lessee must protect all survey monuments, witness corners, reference monuments, and bearing trees against destruction, obliteration, or damage during operations on the lease areas. If any monuments, corners, or accessories are destroyed, obliterated, or damaged by this operation, the lessee will hire an appropriate county surveyor or registered land surveyor to reestablish or restore them at the same locations. Surveying procedures must be carried out in accordance with the Manual of Surveying Instruction for the Survey of Public Lands of the United States, and the surveyor will record the survey in the appropriate county records and send a copy to the authorized officer.

Indian Springs, Atlantic Rim, Northeast Cow Creek, Corral Canyon, and Wild Horse Draw Tracts

1. The lessee shall prepare and submit to BLM, concurrently with the filing of a permit application package, a hydrologic mitigation study, which includes a factual statement of the following:

a. Identification of all affected surface water, water table (unconfined), and artesian (confined) waters, including the location and direction of movement of all groundwater.

b. Appropriate characteristics of the waters, which might include yield or flow; conductance; pH; temperature; alkalinity; total dissolved solids; dissolved amounts of such elements as sulfates, chlorides, barium, cadmium, copper, iron, lead, radioactive materials, etc; turbidity; and total dissolved oxygen.

c. Identification of development activities that would affect the above waters and the probable impact to such waters from each activity.

d. A discussion of the interrelationships between surface and groundwater in the project area and the likely effects to this relationship of developing the Federal coal.

e. Identification of proposed mitigation measures to reduce the impacts identified in (c) above.

f. Identification of impacts to waters and related elements of the environment (e.g., aquatic life, wild-

life habitat, agricultural lands, etc.) that cannot be mitigated.

g. A plan for monitoring surface and groundwater conditions in the project area and downstream from the project. The water quality standards of the Wyoming Department of Environmental Quality and the U.S. Public Health Service shall be used where applicable.

2. In order to protect nesting eagles, prairie falcons, and ferruginous hawks and their associated buffer zones (i.e., pertinent to application of coal unsuitability criteria numbers 11, 13, and 14), no surface coal mining operations will be allowed on such lands. Any exceptions (if granted) for support facilities (e.g., telephone lines, powerlines, pipelines, surface facilities, etc.) will require that no surface disturbing activities are to take place in such areas during breeding and nesting seasons (March 15 - July 15). In addition, such exceptions will be subject to restrictive placement and type or design of facilities, seasonal occupancy, etc. and may be allowed only with prior written permission of the authorized officer. Since these and other bird species (i.e., pertinent to coal unsuitability criteria numbers 11, 12, 13, and 14) may move onto or off a given area or elsewhere in the project area, their activities must be monitored to determine changing protection requirements.

3. Recovery of wildlife habitat on the project area shall be required. The lessee will be required to mitigate habitat loss because of surface coal mining operations in the project area. Mitigation methods may require the lessee to employ techniques for wildlife forage manipulation or intensive wildlife habitat management. Habitat recovery may not be completely feasible in the project area; therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the states, or the lessee outside the project area in combination with recovery and replacement methods on suitable lands within the project area. In regard to the above, the lessee shall be required to develop a habitat recovery and replacement plan designed to protect and/or enhance wildlife habitat. This plan shall be prepared before mining plan approval and shall be prepared in consultation with and subject to approval by BLM, U.S. Fish and Wildlife Service, OSM and the state of Wyoming. The habitat recovery and replacement plan shall include, but is not limited to:

a. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternate methods which were considered and rejected by the lessee and the rationale for the decision to select the proposed methods. The replacement may include, but is not limited to the following techniques:

MITIGATION REQUIREMENTS

(1) Increasing the quantity and quality of forage available to wildlife

(2) The acquisition of wildlife crucial habitats

(3) Manipulation of wildlife habitat for selected wildlife species

(4) Recovery, replacement, or protection of important wildlife habitat by selected methods (e.g., modifying or eliminating fencing, etc.)

(5) Wildlife watering developments

b. A timetable giving the periods of time that will be required to accomplish the habitat recovery or replacement plan and showing how this timetable relates to the overall mining plan.

c. An evaluation of the final plan by the state of Wyoming. The state will comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If the state has recommended alternate methods, the lessee shall consider the state's recommendations and, if the lessee rejects the state's recommendations, the lessee shall indicate its reasons as required by provision 2 above. If no state comment is included in the plan, the lessee shall verify its consultation with the state and the plan may be considered without state comment.

d. A habitat analysis of the lease area and those areas considered for off-site mitigation that identifies:

(1) Distribution of important wildlife species (game, nongame, sensitive species, species of high Federal interest, and threatened and endangered species)

(2) Distribution of important standard habitat types

Atlantic Rim Tract

In conducting the coal unsuitability review for the project area, portions of the Separation Creek and Muddy Creek drainages passing through or near the project area were identified as possible alluvial valley floor areas (coal unsuitability criterion number 19). These identified possible alluvial valley floor areas, or other areas near them where the proposed coal mining could interrupt or intercept water flow to farming areas along the drainages, may only be mined subject to mitigation measures for alluvial valley floor protection that are made a part of an approved mine plan. Determination of alluvial valley floor areas and mitigation measures (if possible) is usually made by the state of Wyoming at the mining plan approval and mine permitting stage.

Corral Canyon Tract

1. A Class III cultural resource inventory has been conducted on the Corral Canyon Tract. One cultural resource site, 48CR256, has been formally determined eligible for listing on the National Register of Historic Places. The consultation process required by 36 CFR 800 under the National Historic Preservation Act of 1966, as amended, has been completed for this cultural resource. A mitigation plan has been developed through this consultation process to adequately mitigate the adverse effect to this site from the proposed action. The lessee shall conduct a data recovery mitigation program at site 48CR256 in accordance with the approved mitigation plan on file at the Rawlins BLM District Office; the Advisory Council on Historic Preservation, Western Division of Project Review; Wyoming Department of Environmental Quality; and Wyoming State Historic Preservation Office. Should the lessee choose to implement an alternative mitigation plan for this site, review and concurrence of the proposed alternative plan will be required by the above listed agencies.

2. Any proposals of the lessee to construct or conduct mining related surface facilities or activities on Federal coal lands within the Corral Canyon area that are within a crucial deer winter range or within a one-quarter mile radius from the center of sage grouse strutting/nesting complexes are subject to stipulations for specific placement, design, and type of facilities and to seasonal occupancy restrictions. Such determinations will be made by the BLM authorized officer on the lessee's submission of any such proposals on such areas on a case-by-case basis. The lessee should understand that such facilities or activities may not be allowable in a given situation or area. The area on the tract of most concern is along the upper half of Coal Creek Rim in Section 14, T. 24 N., R. 86 W.

Indian Springs and Northeast Cow Creek Tracts

In accordance with state law and regulation, the permit application package submittal shall include a detailed description of the effects of possible mined land subsidence and faulting. This must include the proposed measures to be taken to prevent or minimize the effects of subsidence and faulting and procedures that will be taken in terms of backfilling, grading, contouring, etc., in the event any subsidence or faulting occur.

MITIGATION REQUIREMENTS

Indian Springs Tract

1. Any Federal coal recovered from the Indian Springs Tract will be recovered by in situ mining methods only.

2. The lessee shall submit for approval to the BLM, U.S. Fish and Wildlife Service (USFWS), OSM, and state of Wyoming a habitat recovery and replacement plan for protection or enhancement of ferruginous hawk populations affected by habitat loss or displacement for present or historical habitat. The habitat recovery and replacement plan shall be developed in consultation with the BLM, OSM, state of Wyoming, and USFWS. The habitat recovery and replacement plan may be submitted before or concurrently with the filing of the permit application package. However, because serious impacts can result from an inadequate plan, the BLM, OSM, state of Wyoming, and USFWS will be allowed a minimum of 120 days to review the habitat recovery and replacement plan and to resolve any conflicts or problem areas in the plan. Close coordination with the BLM, OSM, state of Wyoming, and USFWS during development of the plan will minimize the time needed for review and concurrence.

The final habitat recovery and replacement plan shall indicate the methods to be employed by the lessee that will ensure that ferruginous hawk productivity and species diversity will not decline in the area.

Northeast Cow Creek Tract

Any Federal coal mined from the Northeast Cow Creek Tract will be recovered by subsurface mining methods only.

Winton Tract

The lessee will protect existing raptor nests and their buffer zones within the tract as well as migratory bird habitat pertinent to application of coal unsuitability criteria 11, 12, 13, and 14. Any exceptions granted for support facilities (e.g. telephone lines, powerlines, ventilation shafts, etc.) will be subject to restrictive placement and type of design of facilities, seasonal occupancy, etc., and may be allowed only with prior written permission of the authorized officer.

All Colorado Tracts

1. The lessee shall be required to mitigate for pronghorn antelope, mule deer, elk, sharp-tailed grouse, and sage grouse habitat loss and the resultant loss or displacement of this species, as a key indicator species, due to coal mining operations. The lessee shall be required to submit for approval to the Authorized Officer a habitat recovery and replacement plan for protection or enhancement of the pronghorn antelope, mule deer, elk, and sharp-tailed and sage grouse populations affected by habitat loss or displacement from historic habitat.

The habitat recovery and replacement plan shall be developed in consultation with the Authorized Officer, the Office of Surface Mining, and the Colorado Division of Wildlife (CDOW) based on estimates of lost and disturbed habitat as described in the Site-Specific Analysis for each tract and the Green River-Hams Fork Round II EIS. If the mine plan submitted by the lessee indicates figures different from the lost habitat estimates used in these documents as to quality and quantity of habitat lost or disturbed, mitigation alternatives shall be recalculated based upon revised data contained in the mining plan.

The final habitat recovery and replacement plan shall indicate the methods to be employed by the lessee which will ensure that the carrying capacity of the recovered or replaced land has the capacity to support this indicator species as agreed upon by the Authorized Officer and CDOW.

Mitigation methods may require the lessee to employ techniques for wildlife range manipulation or intensive wildlife range management. Habitat recovery may not be completely feasible in the permit area; therefore, recovery or replacement may be accomplished on lands made available through the surface management agency, the state, or the lessee outside the permit area in combination with recovery and replacement methods on suitable lands within the permit area.

The habitat recovery and replacement plan shall include the following:

a. A habitat analysis of the permit area which:

(1) Identifies the above species which occupy the permit area

(2) Includes an analysis of the quality or carrying capacity of the habitat of this species

b. A detailed description of the methods selected by the lessee to mitigate habitat loss, together with a comparative analysis of alternate methods which were considered and rejected by the lessee and the rationale for the decision to select the proposed

MITIGATION REQUIREMENTS

methods. The methods utilized by the lessee for recovery and replacement may include, but are not limited to, the following techniques:

(1) Increasing the quantity and quality of forage available to wildlife

(2) Acquiring critical wildlife habitats

(3) Utilizing mechanical manipulation of low quality wildlife habitat to increase its carrying capacity for selected wildlife species

(4) Using selected fencing for recovery, replacement, or protection of important wildlife habitat

c. A timetable giving the periods of time which will be required to accomplish the habitat recovery or replacement plan and showing how this timetable relates to the overall mining plan.

d. An evaluation of the final plan by CDOW. CDOW shall comment on the methods selected and the techniques to be employed by the lessee and may recommend alternate recovery or replacement methods. If CDOW has recommended an alternate method, the lessee shall consider CDOW's recommendation and, if the lessee rejects CDOW's plan, the lessee shall indicate its reasons as required by provision 2 above. If no CDOW comment is included in the plan, the lessee shall verify its consultation with CDOW and the plan may be considered without CDOW comment.

2. The lessee shall grant public access to public land adjacent to the lease by means of existing roads, trails, or ways. If the lessee must destroy or obstruct an existing route, the lessee shall provide an alternate route of equal quality. Public lands within the lease area and roads, trails, and ways constructed by the lessee shall be made accessible to the public unless such access would interfere with mining operations or create a safety hazard. Limiting access within one-half mile of buildings and work areas should be adequate for this purpose. Any additional limitation must be approved by BLM.

Middle Creek, Lay Creek, Horse Gulch, Peck Gulch, Fish Creek, and Williams Fork Mountain Tracts

Flood plains identified below are protected by the following stipulation: No surface occupancy or surface disturbance related to mining activity will be allowed.

In Middle Creek Tract, Trout and Little Middle creeks: those areas inundated by the 100-year flood peak stage in and paralleling the mainstream bottoms, and those areas encompassing 200 feet

adjacent to each bank of the mainstream channels: in Trout Creek in T. 4 N., R. 86 W., sec. 28; and in Little Middle Creek in T. 4 N., R. 86 W., sec. 20 and 28 (calculated from data in USGS, 1982).

In Lay Creek Tract, Lay Creek and Bord Gulch: those areas inundated by the 100-year flood peak stage (1,700 cfs) in and paralleling the mainstream bottoms, and those areas 200 feet adjacent to each bank of the mainstream channels: in Lay Creek, sec. 21, lots 5 to 8, and sec. 22, N1/2SW1/4SW1/4; T. 8 N., R. 93 W., sec. 32, lots 1, 4, 6, 10, and 15; and in Bord Gulch, sec. 20, lot 2; T. 8 N., R. 93 W., sec. 29, lots 1 and 10.

In Horse Gulch Tract, Horse, Sand Spring and Fuhr Gulch: those areas inundated by the 100-year flood peak stage in and paralleling the mainstream bottoms and those areas encompassing 300 feet adjacent to each bank of the mainstream channels: in Horse Gulch in T. 6 N., R. 93 W., sec. 14 and 15; in Sand Spring Gulch in T. 6 N., R. 93 W., sec. 24 and 25; and in Fuhr Gulch in T. 6 N., R. 93 W., sec. 29 and 32.

In Peck Gulch Tract, Spring and Peck gulches: those areas inundated by the 100-year flood peak stage in and paralleling the mainstream bottoms and those areas encompassing 100 feet adjacent to each bank of the mainstream channels: in Peck Gulch in T. 5 N., R. 90 W., sec. 13; and in Spring Gulch in T. 5 N., R. 90 W., sec. 11 and 12.

In Fish Creek Tract, those areas inundated by the 100-year flood peak stage in and paralleling the mainstream bottoms and those areas encompassing 300 feet adjacent to each bank of the mainstream channels: in Fish Creek in T. 5 N., R. 87 W., sec. 36, NW1/4NW1/4NW1/4, and in T. 5 N., R. 87 W., sec. 34, the entire length of Fish Creek in the southeast corner.

In Williams Fork Mountain Tract, Jeffway and Spring Gulches: in and paralleling the mainstream bottoms and those areas encompassing 100 feet adjacent to each bank of the mainstream channels; in East Fork Jeffway Gulch in T. 5 N., R. 90 W., sec. 2, 3, and 10; in Main Fork Jeffway Gulch, in T. 5 N., R. 90 W., sec. 3, 4, and 9; and Spring Gulch, T. 5 N., R. 90 W., sec. 2, 11, 12, and 14.

Horse Gulch, Bell Rock, Iles Mountain, Middle Creek, and Prairie Dog Tracts

1. All tracts which affect powersite withdrawals shall have the following stipulation incorporated into the lease:

a. If any of the land covered by this lease or permit was, on the date the lease or permit applica-

MITIGATION REQUIREMENTS

tion or offer was filed, within a powersite classification, reservation, or project on which an application for a license or preliminary permit is pending before the Federal Power Commission or on which an effective license or preliminary permit had been issued by the Federal Power Commission under the Federal Power Act, or on which an authorized power project (other than one owned or operated by the Federal Government) had been constructed, the United States, its permittees or licensees shall have the prior right to use such land for purposes of power development so applied for, licensed, permitted, or authorized and no compensation shall accrue to the mineral lessee or permittee for loss of prospective profits or for damages to improvements or workings, or for additional expense caused the mineral lessee as a result of the taking of said land for power development purposes. It is agreed, however, that where the mineral lessee or permittee can make adjustments of his improvements to avoid undue interference with power development, he will be permitted to do so at his own expense. Furthermore, occupancy and use of the land by the mineral lessee or permittee shall be subject to such reasonable conditions with respect to the use of the land as may be prescribed by the Federal Power Commission for the protection of any improvements and workings constructed thereon for power development.

b. If any of the land covered by this lease or permit is on the date of the lease or permit within a powersite classification or reservation which is not governed by the preceding paragraph, the lease or permit is subject to the express condition that operations under it shall be so conducted as not to interfere with the administration and use of the land for powersite purposes to a greater extent than may be determined by the Secretary of the Interior to be necessary for the most beneficial use of the land. In any case, it is agreed that where the mineral lessee or permittee can make adjustments to avoid undue interference with power development, he will be permitted to do so at his own expense.

Prairie Dog Tract

1. To protect nesting golden eagles and ferruginous hawks, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually in the following areas:

- T. 3 N., R. 100 W.,
sec. 30, N1/2NE1/4, NW1/4, N1/2SW1/4, NW1/4SE1/4, and N1/2SW1/4SE1/4
T. 3 N., R. 101 W.,
sec. 19, NE1/4, SW1/4, W1/2SE1/4, and E1/2SE1/4
sec. 20, all

- sec. 21, W1/2 and W1/2E1/2
sec. 25, NE diagonal
T. 3 N., R. 102 W.,
sec. 24, SE1/4SE1/4
sec. 25, NE1/4NE1/4 and NE1/4SE1/4NE1/4
2. To protect sage grouse strutting grounds, no surface occupancy will be allowed at any time and no activity will be allowed between March 1 and May 30 annually in the following area:
T. 3 N., R. 100 W.,
sec. 30, SE1/4SW1/4 and SW1/4SE1/4
sec. 31, NW1/4NE1/4 and NE1/4NW1/4
3. To protect wintering bald eagles, no activity between October 15 and April 15 annually will be allowed in the following areas:
T. 2 N., R. 100 W.,
sec. 6, S1/2S1/2
T. 2 N., R. 101 W.,
sec. 1, S1/2S1/2SE1/4

Rattlesnake Mesa

To protect nesting golden eagles, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually on the following lands:

- T. 2 N., R. 93 W.,
sec. 19, SE1/4SE1/4
sec. 30, S1/2NW1/4NE1/4SE1/4, SW1/4NE1/4SE1/4, SE1/4NE1/4SE1/4, S1/2NE1/4NW1/4SE1/4, SW1/4NW1/4SE1/4, SE1/4NW1/4SE1/4, SW1/4SE1/4, and SE1/4SE1/4
sec. 31, NE1/4, E1/2SE1/4, and NW1/4SE1/4
sec. 32, SW1/4NW1/4, W1/2NW1/4SE1/4NW1/4, W1/2SW1/4SE1/4NW1/4, N1/2NE1/4NW1/4SW1/4, SW1/4NE1/4NW1/4SW1/4, NW1/4NW1/4SW1/4, SW1/4NW1/4SW1/4, and W1/2SE1/4NW1/4SW1/4

Iles Mountain

To protect nesting golden eagles, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually in the following areas:

- T. 5N., R. 92 W.,
sec. 23, W1/2SE1/4

MITIGATION REQUIREMENTS

Fish Creek Tract

1. To protect nesting golden eagles, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually in the following areas:

- T. 4 N., R. 87 W.,
 - sec. 12, SE1/4 and SE1/4NE1/4
 - sec. 13, N1/2NE1/4
- T. 4 N., R. 86 W.,
 - sec. 7, lots 7, 8, 13, and 14
 - sec. 18, lot 4

2. One alluvial valley floor will be protected from disturbance related to coal mining. The following stipulation will apply to the area described below: No surface occupancy or surface disturbance related to coal mining activity will be allowed. Fish Creek is delineated as follows: those areas in and paralleling the mainstream bottoms and those areas encompassing 300 feet adjacent to each bank of the mainstream channels, in Fish Creek in T. 5 N., R. 87 W., sec. 36, NW1/4NW1/4NW1/4, and in T. 5 N., R. 87 W., sec. 34, the entire length of Fish Creek in the southeast corner.

3. No surface occupancy or other surface disturbing activities will be allowed at any time in the following area:

- T. 5 N., R. 87 W., 6th PM,
 - sec. 25, lots 1, 2, 3, and 4

Bell Rock Tract

1. To protect nesting golden eagles, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually in the following areas:

- T. 6 N., R. 91 W.,
 - sec. 31, lot 9
- T. 6 N., R. 92 W.,
 - sec. 25, Lot 1, S1/2NE1/4

2. To protect wintering bald eagles, no surface occupancy will be allowed at any time and no activity will be allowed between November 1 and April 15 annually in the following areas:

- T. 6 N., R. 91 W.,
 - sec. 19, lots 6 and 7
 - sec. 30, lots 5, 6, and 8
 - sec. 31, lot 9
- T. 6 N., R. 92 W.,
 - sec. 25, NE1/4

Williams Fork Mountain Tract

To protect nesting golden eagles and prairie falcons, no surface occupancy will be allowed at any time and no activity will be allowed between February 1 and July 31 annually in the following areas:

- T. 5 N., R. 90 W.,
 - sec. 9, lot 3
 - sec. 14, lots 3 and 4

Lay Creek Tract

1. To protect sage grouse strutting grounds, no surface occupancy will be allowed at any time, and no activity will be allowed between March 1 and May 31 annually in the following area:

- T. 8 N., R. 94 W.,
 - sec. 25, N1/2SE1/4

2. To protect golden eagle nests, no surface occupancy will be allowed at any time, and no activity will be allowed between February 1 and July 31 annually on the following areas:

- T. 7 N., R. 94 W.,
 - sec. 2, S1/2SW1/4, W1/2SE1/4, SW1/4NE1/4, W1/2SE1/4NE1/4, and W1/2E1/2SE1/4
 - sec. 3, lot 8, E1/2SE1/4SE1/4, SW1/4NW1/4, W1/2SW1/4, W1/2SE1/4NW1/4, and W1/2E1/2SW1/4
 - sec. 4, lot 5, S1/2N1/2, E1/2E1/2SW1/4, and SE1/4
- T. 8 N., R. 92 W.,
 - sec. 31, lot 5
- T. 8 N., R. 93 W.,
 - sec. 32, lot 1
- T. 8 N., R. 94 W.,
 - sec. 33, SW1/4, W1/2SE1/4, and W1/2E1/2SE1/4

GLOSSARY

- ACID MINE DRAINAGE.** Any acid water which drains off, flows on, or has drained or flowed off any area of land affected by mining.
- ACRE-FOOT.** The volume of water (43,560 cubic feet) required to cover 1 acre to a depth of 1 foot.
- ACTIVITY DAY.** Participation in a recreation activity by one person for any period of a day; actual visits.
- AD VALOREM.** In proportion to the value. Ad valorem taxes are based on property or other values.
- AIR BASINS.** Areas in which weak dispersion conditions result from the effects of obstructions on the normal wind flow pattern. These obstructions consist of elevated topographic features, such as mountain ranges or canyon walls.
- ALLUVIAL.** Pertaining to or composed of any sediment deposited by flowing water; for example, in a river bed.
- ALLUVIAL VALLEY FLOOR.** Valley that is filled up with alluvium (sediments that have been transported by water).
- ALLUVIUM.** Gravel, sand, silt, clay, or similar detrital material deposited or moved by running water; alluvium is unconsolidated.
- AMBIENT AIR QUALITY.** The state of the atmosphere at ground level as defined by the range of measured and/or predicted ambient concentrations of all significant pollutants for all averaging periods of interest.
- ANGLE OF DIP.** The angle an inclined stratum makes with the horizontal (see dip).
- ANOMIE.** Formlessness. At the community level, the sense of a coherent and meaningfully integrated set of behavioral expectations by large numbers of citizens has been lost: i.e., people in the town no longer know 'what to expect' from other people or from the community institutions. At the individual level, a person feels confused about what is expected of him--old values no longer seem to apply, the old ways no longer seem to be the 'right' ways. For an individual, anomie may lead to mental breakdown; for a community, structural breakdown has occurred.
- ANTHROPOGENIC.** Relating to man's activities. Anthropogenic pollutant sources include space heating, vehicular traffic, industrial activity, and construction.
- ANTICLINE.** A fold with strata (horizontal layers) sloping downward on both sides from a common crest or axis.
- AQUIFER.** A water-bearing bed or stratum (layer) of permeable rock, sand, or gravel capable of yielding adequate quantities of water.
- ARCHAEOLOGICAL.** Pertaining to human activity prior to the time or scope of written records.
- ARTESIAN.** Is synonymous with confined. Artesian water and artesian water body are equivalent respectively to confined groundwater and confined water body (see GROUND-WATER CONFINED).
- ARTESIAN WELL.** A well deriving its water from an artesian or confined water body. The water level in an artesian well stands above the top of the artesian water body it taps.
- ATMOSPHERIC DISPERSION MODEL.** A mathematical simulation of the atmospheric transport and dispersion of pollutants used to predict pollutant concentrations.
- ATTITUDE.** An intellectual or emotional position regarding a fact, condition, state, person, or other entity, producing a readiness to act in a certain manner.
- BACKGROUND CONCENTRATION.** A pollutant level which could be expected in an area in the absence of additional anthropogenic pollutant sources.
- BAGHOUSE.** A stationary source pollution control system designed to filter particulates at over 99 percent efficiency.
- BASE FLOW.** Stream flow derived from groundwater discharge into the waterway.
- BED.** A subdivision of a stratified sequence of rocks, lower in rank than a member or formation, internally composed of relatively homogeneous material exhibiting some degree of lithologic unity, and separated from the rocks above and below by visually or physically more or less well-defined boundary planes; 'the smallest rock-stratigraphic unit recognized in classification'.
- BEDROCK.** The more or less solid rock in place either on or beneath the surface of the earth.
- CHANNEL STABILITY.** A relative term describing a channel's condition with respect to erosion or movement of the channel walls or bottom due to water flows.
- CLIMATE.** The statistical collective of an area's weather conditions during a relatively long interval of time (usually several decades.)
- COMMUNITY FACILITIES AND SERVICES.** Equipment and activities which support the economic and residential functions of an area. Examples are schools, police, and water systems. As used in this study, the term is limited to those that are provided by local communities and school districts.
- CONSUMPTIVE USE.** The quantity of water discharged to the atmosphere or incorporated in the products of the process in connection with domestic use, vegetative growth, food processing, or an industrial process.
- CONTINUOUS MINER.** A mining machine designed to remove coal from the face and load it onto cars or conveyors without the use of cutting machines, drills, or explosives.
- CONTRAST.** The relative difference in luminance between an object and its background. Inherent contrast is contrast as perceived at the position of the observed object. Apparent contrast is contrast as perceived at the observer's position.
- CUBIC FEET PER SECOND (cfs).** A unit expressing rates of discharge, equal to the discharge flowing through a rectangular cross section one foot wide by one foot deep at an average velocity of one foot per second.
- CULTURAL RESOURCE.** Evidence of human activity which occurred at least 50 years ago. For convenience the evidence is subdivided as archaeological and historical.
- DEMOGRAPH.** The statistical study of human population; includes size, density, distribution, and vital statistics.
- DEWATER.** To remove water from; dehydrate.
- DIP.** The angle that a structural surface, e.g., a bedding or fault plane, makes with the horizontal, measured perpendicular to the strike of the structure.
- DIP SLOPE.** A slope of the land surface, roughly determined by and approximately conforming with the direction and the angle of dip of the underlying rocks; specifically the long, gently inclined face of a hill or ridge with a steep face on one side and a gentle slope on the other.
- DISCHARGE WEIGHTED AVERAGE DISSOLVED SOLIDS.** See weighted-average concentration.
- DISPERSION POTENTIAL.** The ability of the atmosphere to dilute or disperse air pollutants, as determined by normal ventilation values. A high dispersion potential results from high ventilation values, which can be caused by high transport wind speeds, high mixing heights, or high values of both.
- DISSOLVED OXYGEN.** The amount of dissolved oxygen, in parts per million by weight, present in water, now generally expressed in milligrams per liter. A critical factor for fish and other aquatic life and for self-purification of a surface-water body after inflow of oxygen-consuming pollutants.
- DISSOLVED SOLIDS.** Solids that originate mostly from rocks and are in solution. Some colloidal material is treated as if it were in solution in determining dissolved solids. The total dissolved mineral constituents of water.
- DISSOLVED-SOLIDS YIELD.** A unit for expressing the discharge of dissolved solids from an area. Dissolved-solids yield is usually given in tons per square mile per year.
- DIURNAL.** Pertains to meteorological actions that are completed over a day and night cycle.
- DOWN DIP.** A direction that is downwards and parallel to the dip of a structure or surface.

GLOSSARY

ECONOMIC BASE. Economic activities which sell products or services outside of the area, thus bringing additional money into the area.

ECONOMIC MODEL. A mathematical representation of an area's economy.

EFFLUENT. Liquid wastes (as industrial refuse or sewage) discharged into the environment.

EMISSION FACTOR. An empirically derived mathematical relationship between pollutant emission rate and some characteristic of the source, such as volume, area, mass, or process output.

EN ECHELON. Parallel structural features (folds, faults, etc.) that are offset like the edges of shingles on a roof when viewed from the side.

EPHEMERAL STREAM. A stream that flows for less than 30 consecutive days, which flows only in direct response to precipitation in the immediate watershed, and which has a channel bottom that is always above the local water table.

EROSION. The process by which the surface of the earth is worn away by the action of water, glaciers, winds, etc.

EUTROPHICATION. A state in which there is an abundant accumulation of nutrients that support a dense growth of plant and animal life in a body of water, the decay of which depletes oxygen in shallow water in the summer.

EVAPORATION. The physical process by which a liquid is transformed to the gaseous state.

EVAPOTRANSPIRATION. The combined loss of water from a given area during a specific period of time by evaporation from the soil or water surface and by transpiration from plants.

FAULT. Breaks in the continuity of the body of rock, with dislocation along the plane of fracture.

FECAL COLIFORM. A type of bacteria found in the waste excretions of warm-blooded animals; used as the prime indicator of organic fecal pollution.

FLOOD PLAIN. That portion of a river channel, which is built of sediments during the present regimen of the stream and which is covered with water when the river overflows its banks at flood stages.

FORMATION. The primary unit of formal mapping or description. Most formations possess certain distinctive, or combinations of distinctive, lithic features.

FUGITIVE DUST. A type of particulate emission made airborne by forces of wind, man's activity, or both, resulting from unpaved roads, construction sites, tilled land, or windstorms.

GAGING STATION. A particular site on a stream or reservoir where systematic observations of gage height, discharge, or water quality parameters (or any combination of these) are or have been obtained. Usually equipped with a device to automatically record the gage height of the stream.

GALLONS PER MINUTE (GAL/MIN). A unit expressing rate of discharge. One cubic foot per second is equal to 448.8 gal/min or 646,272 gal/day (gallons per day).

GEMEINSCHAFT. A model of social relations based upon informal rather than formal structures and social controls, and upon primary rather than secondary group interaction. The opposite end of the continuum is Gesellschaft relationships, based upon formal structures and secondary group interaction. Gemeinschaft relationships typify small, rural isolated communities or societies. Neither extreme of the continuum is pure.

GEOMORPHOLOGY. A branch of geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of landforms.

GROUNDWATER. That part of subsurface water that completely saturates the rocks and is under hydrostatic pressure.

GROUNDWATER, CONFINED. Groundwater under pressure significantly greater than atmospheric. Its upper limit is the bottom of a bed of distinctly lower hydraulic conductivity than that of the material in which the confined water occurs.

GROUNDWATER, PERCHED. Unconfined groundwater separated from an underlying body of groundwater by an unsaturat-

ed zone. Its water table is a perched water table. It is held up by a perching bed whose permeability is so low that water percolating downward through it is not able to bring water in the underlying unsaturated zone above atmospheric pressure. Perched groundwater may be either permanent, where recharge is frequent enough to maintain a saturated zone above the perching bed, or temporary, where intermittent recharge is not great or frequent enough to prevent the perched water from disappearing from time to time as a result of drainage over the edge of or through the perching bed.

GROUNDWATER, UNCONFINED. Groundwater in an aquifer that has a water table.

GROUP. A rock-stratigraphic unit containing two or more formations.

GROWING SEASON. Generally, the period of the year during which the temperature of cultivated vegetation remains sufficiently high to allow plant growth.

HISTORICAL. For this region, pertaining to human activity from 1776 until 50 years ago.

HYDRAULIC. Of or pertaining to fluids in motion; conveying, or acting, by water.

HYDRAULIC GRADIENT. Pressure gradient. As applied to an aquifer, it is the rate of change of pressure head per unit of distance of flow at a given point and in a given direction.

HYDROCARBON. A chemical compound composed principally of carbon and hydrogen, but also containing varying amounts of other elements (i.e., sulfur, nitrogen, chlorine).

IMPERMEABLE. Applied to strata such as clays, shales, etc., that do not permit water to move through them under the head differences ordinarily found in groundwater.

INDIRECT IMPACTS. Impacts caused by something which, itself, is a result of something else. In economics, indirect impacts are caused by growth in trade and service activities which, themselves, result from a primary source of growth such as mining.

INFRASTRUCTURE. See COMMUNITY FACILITIES AND SERVICES.

INHALABLE PARTICULATES. Particles less than 10 microns in diameter which are not filtered in the nostrils and can be lodged in the windpipe and lungs, causing health damage.

IN-PLACE COAL RESOURCES. Total coal estimated to be present.

INTERMITTENT STREAM. A stream that flows for at least one month of the calendar year as a result of groundwater discharge or surface runoff.

JOINT FREQUENCY DISTRIBUTION. Set of meteorological data describing the concurrent frequencies of occurrence of defined wind directions, wind speed classes, and atmospheric stabilities.

LITHOLOGY. The physical character of rocks.

LONGWALL. Pertaining to a means of extracting coal or other minerals in an underground mine from a continuous face.

MAINTENANCE LEASE. A lease required to maintain an existing mining operation at its current average annual level of production, or to supply coal for contracts signed prior to July 19, 1979, or both.

MEMBER. A division of a formation differentiated by separate or distinct lithology or complex of lithologies.

mg/l. Abbreviation for milligrams per liter, the unit of expression for the concentration of dissolved minerals in water.

MINEABLE COAL. Coal resources that can be economically extracted. Based on bed (seam) thickness, overburden thickness, quality of coal, quantity of coal, and availability of transportation and coal market.

MIXING HEIGHT. The height above the ground to which turbulence causes the air to be well mixed.

MODELING. A mathematical or physical representation of an observable situation. In air pollution control, models afford the ability to predict pollutant distribution or dispersion from identified sources for specified weather conditions.

GLOSSARY

NATIONAL REGISTER OF HISTORIC PLACES. "...A register of districts, sites, buildings, structures, and objects of national, state, or local significance in American history, architecture, archaeology, and culture..."--36 CFR 800.2 (d).

OVERBURDEN. All the earth and other materials which lie above a natural deposit of minerals.

PER CAPITA. Per unit of population. Per capita projections assume the same growth rate as population.

PERENNIAL STREAM. A stream that flows continuously during all of the calendar year as a result of groundwater discharge or surface runoff.

PERMEABILITY. (1) The quality of a soil horizon that enables water or air to move through it. (2) The property or capacity of a porous rock sediment or of soil for transmitting a fluid without impairment of the structure of the medium; it is a measure of the relative ease of fluid flow under unequal pressure.

pH. A measure of the acidity or alkalinity of a solution. Water is considered to be neutral at a pH of 7, acid if pH is less than 7, and basic if greater than 7.

PHOTOCHEMICAL REACTION. Chemical reaction in which the activation energy (driving force) is supplied by solar radiation.

PHYSIOGRAPHIC PROVINCE. A region of similar structure and climate that has had a unified geomorphic history.

POINT SOURCE. A pollutant source whose origin of emissions can be approximated by a single point.

POLLUTANT. Any gaseous, chemical, or organic waste that contaminates air, soil, or water.

POLLUTION. The contamination of soil, water, or the atmosphere by the discharge of noxious substances.

PREVAILING WIND. The most frequent compass direction from which the wind blows.

QUASI-EQUILIBRIUM. A condition of approximate equilibrium.

RADIATIONAL COOLING. The cooling of the earth's surface and adjacent air, accomplished (mainly at night) whenever the earth's surface suffers a net loss of heat.

RECHARGE. Inflow to a groundwater reservoir (aquifer system in which ground-water is stored).

RECLAMATION. The process of returning disturbed lands to their former or other productive uses.

RECOVERABLE COAL. The quantity of coal ultimately extracted. Mineable coal not recovered is left in margins and spoils of surface mines and as pillars and barriers in subsurface mines.

REGIONAL VISIBILITY. Visibility predicted to occur in the region around a source or group of sources resulting from particulate, sulfate, and nitrate concentrations in the vicinity of these sources.

RIPARIAN. Situated on or pertaining to the bank of a river, stream, or other body of water. Normally used to refer to the plants of all types that grow along streams, around springs, etc.

ROOM-AND-PILLAR. A system of mining in which the coal or ore is mined in rooms separated by narrow ribs or pillars. The coal or ore in the pillars is removed by subsequent working in which the roof is caved in successive blocks.

RUNOFF. That part of the precipitation that appears in surface streams. It is the same as streamflow unaffected by artificial diversions, storage, or other works of man, in or on the stream channels or on the drainage area.

SALINITY. Measure of the total dissolved solids concentration in water.

SANDSTONE. A medium-grained, sedimentary rock composed of abundant, rounded or angular fragments of sand size set in a fine-grained matrix (silt or clay) and more or less firmly united by a cementing material (commonly silica, iron oxide, or calcium carbonate); the consolidated equivalent of sand.

SECONDARY IMPACTS. See INDIRECT IMPACTS.

SEDIMENT. Fragmented material that originates mostly from rocks and is transported by, suspended in, or deposited from water or air.

SEDIMENTATION. The settling out of solids from water by gravity to form unconsolidated alluvial deposits.

SEDIMENT YIELD. A unit for expressing the discharge of sediment from an area. Sediment yield is usually given in acre-feet or tons per square mile per year.

SHALE. A fine-grained, fissile (capable of being split) sedimentary rock formed by the consolidation (as by compression or cementation) of clay, silt, or mud and characterized by finely stratified structure.

SILTSTONE. A very fine-grained rock, mainly consolidated silt.

SITE-SPECIFIC. A specific project area analyzed in the environmental statement.

SOCIAL GROUP. An abstract structuring of two or more social statuses tied meaningfully together by reciprocal behavioral expectations (norms). Becomes 'visible' only when actual persons occupy the various positions and behave toward each other in recognizable conformity to the expectations.

SOCIAL IMPACT. "The difference which (energy development)...makes in the lives of those concerned." (Gold, 1976, p. 3).

SOCIAL-PSYCHOLOGICAL. Having to do with the psychological consequences for the individual of living and interacting with other people within a particular social-structural system and in a particular cultural context.

SOCIAL STRUCTURE. A more or less integrated system of interacting groups in a community or society which provides the social framework within which the ongoing activities of the community or society are carried out and which provides the various dimensions defining the overall position of each individual within that community or society.

SOCIAL SUPPORT SYSTEM. A range of more or less enduring relationships which help individuals define and cope with life events. They help reduce susceptibility to psychological stress by supplying cognitive guidance, helping to master emotional burdens, providing refuge from stressful environment, and helping realistic interpretation of responses from others (adapted from Lantz and McKeown, 1979, p. 51).

SPECIFIC CONDUCTANCE. A measure of the ability of water to conduct an electrical current, expressed in micromhos per centimeter at 25 degrees Centigrade. Conductance serves as an index to the concentration of dissolved solids in the water.

SPOIL. The overburden removed in strip mining. Debris or waste material from a strip mine.

SPOILS AQUIFER. Unconfined aquifer formed by partial saturation of spoils materials replaced in surface mined areas.

STRATOSPHERIC. Pertaining to the stratosphere, the atmospheric layer above the tropopause; a very stable layer characterized by low moisture content and absence of clouds.

STREAM FLOW. Water flowing within a stream channel.

STREAM(S). Any body of running water, great or small, moving under gravity flow to progressively lower levels in a relatively narrow but clearly defined channel on the surface of the ground.

STRUCTURE. Any visible signs of displacement or deformation of the rock such as faulting or folding.

SUBSIDENCE. A sinking down of a part of the earth's crust. Lowering of the strata, including the surface, due to underground excavations.

SURFACE RUNOFF. The runoff that travels over the soil surface to the nearest surface stream; runoff of a drainage basin that has not passed beneath the surface since precipitation.

SURFACE WATER. Waters on the surface of the earth, including water in streams, lakes, ponds, ice, snow, glaciers, etc.

SUSPENDED SEDIMENT. Sediment that is supported by the upward components of turbulent currents, or by colloidal suspension if the sediment particles are very small.

SYNCLINE. A low, troughlike area in bedrock in which rocks incline together from opposite sides.

SYNOPTIC. Weather patterns associated with high and low pressure systems in the lower troposphere.

GLOSSARY

TECTONIC. Of, pertaining to, or designating the rock structure and external forms resulting from the deformation of the earth's crust.

TELERADIOMETER. An instrument which measures the apparent radiance of a target and its apparent background radiance, which can be interpreted as visual range.

TONGUE. Part of a formation that is known to wedge out laterally.

TOPOGRAPHY. The exact physical features and configuration of a place or region; the detailed and accurate description of a place or region.

TOTAL SUSPENDED PARTICULATES (TSP). The portion of the total particulate matter in the atmosphere consisting of particles so small that the particles settle out very slowly.

TRANSPORT WIND. The average horizontal wind speed component perpendicular to a vertical cross section of the atmosphere. In this report, the vertical limits are defined by the ground and the mixing height.

USE (WATER). The total quantity of water pumped, diverted, applied, or utilized for any purpose.

VENTILATION. A measure of the amount of air moving through a vertical cross section of the atmosphere. The higher the ventilation, the higher the dispersion. As used in this report, it is the product of the mixing height and the transport wind.

VISIBILITY. A measurement of the maximum distance to which large objects may be viewed. Fixed reference objects such as mountains, hills, towers, or buildings may be used to estimate visibility.

VISITOR DAY. Participation in a recreation activity by one or more individuals aggregating a total of 12 hours of use.

VISUAL RANGE. A standardized form of visibility that approximates actual observed visibility. It is the maximum distance at which a threshold contrast of .02 at a wavelength of 5,500 Angstroms can be detected between an ideal black object against the horizon sky in daylight.

VISUAL RESOURCE MANAGEMENT (VRM) CLASSES. A method of categorizing scenic values. The following classifications are applied:

Class I: This class provides for natural ecological changes only. It is usually applied to wilderness areas, natural areas, or areas with similar special designations.

Class II: Changes in any of the basic elements (form, line, color, or texture) caused by a management activity should not be evident in the characteristic landscape. It is used for forested areas, high quality scenic areas, river valleys with dense riparian habitat, unique sand dunes, and other scenic areas with diversity in topography and vegetation.

Class III: Changes in basic elements caused by management activity may be evident in the characteristic landscape; however, the changes should remain subordinate to the existing characteristic landscape. These areas usually have average scenic quality.

Class IV: Changes may subordinate the original composition and character but should reflect what could be a natural occurrence within the characteristic landscape. Class IV usual-

ly offers little variety in visual character, with variations in topography and vegetation being very limited.

Class V: Change is needed. This class applies to areas needing reclamation. Good examples are strip mines, intensively developed oil and gas fields, and areas that have been severely overgrazed or overused. It should be considered an interim or short-term classification until one of the other VRM objectives can be met.

WATER DISCHARGE. The flow of a stream or canal, outflow from a basin, or flow of water from a pipe. Water discharge includes the sediment mixed with and solids dissolved in the water.

WATER RESOURCES. A general term referring to the total availability of water on or in the ground for use by animals or people.

WATERSHED. The region draining into a river, river system, or body of water.

WATER SUPPLY. A source or volume of water available for use; also, the system of reservoirs, wells, conduits, treatment facilities, etc., required to make the water available and usable; often but not always equivalent to WATER RESOURCES.

WATER TABLE. The surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere. Synonyms: water level, groundwater level.

WATER TYPE. A term used to denote the predominant cations and anions in water. Whether certain cations (calcium, magnesium, sodium, and potassium), and certain anions (bicarbonate, sulfate, and chloride), predominate depends on the concentrations in equivalents per million and the relation of the concentration of the individual ions to each other. For example, if the concentration of sodium makes up most of the total cations, and the concentration of bicarbonate makes up most of the total anions, the water is classified as a sodium bicarbonate type. However, if the second most abundant cation or anion is more than half the most abundant cation or anion, and the third most abundant cation or anion is more than half the second, they are included in the water-type classification in order of magnitude. Examples of these more complex water types would be calcium magnesium bicarbonate, calcium magnesium bicarbonate sulfate, and sodium magnesium calcium chloride sulfate.

WATER YIELD. The runoff from a drainage basin.

WEIGHTED-AVERAGE CONCENTRATION. A discharge-weighted average that approximates the dissolved solids concentration of water that would be found in a reservoir containing all the water passing a given station during a specified period after thorough mixing in the reservoir. The effects of evaporation, precipitation, or the addition or removal of dissolved constituents by plants or animals is not considered in this definition.

WIND ROSE. A graphical display of wind speed and wind direction frequencies at a meteorological station. The bar graphs extend into the direction from which the wind blows. These directions are the 16 compass point directions (i.e., north, north-northeast, ..., northwest, and north-northwest).

ACRONYMS AND ABBREVIATIONS

AUM. Animal Unit Month

BLM. Bureau of Land Management

DHV. Design Hourly Volume

EIS. Environmental Impact Statement

FLPMA. Federal Land Policy and Management Act of 1976

GR-HF. Green River-Hams Fork

HAA. Habitat Analysis Area

NEPA. National Environmental Policy Act

OSM. Office of Surface Mining

RCT. Regional Coal Team

SSA. Site-Specific Analysis

TSP. Total Suspended Particulates

USGS. U.S. Geological Survey

REFERENCES

- ALBRECHT, S.L., n.d. "Socio-cultural Factors and Energy Resource Development in Rural Areas in the West" Unpublished paper, Brigham Young University, Provo, Utah.
- ATHEARN, F.J., 1981. *An Isolated Empire: A History of Northwest Colorado* Denver, Colorado: Bureau of Land Management.
- BAGGS, WY., PLANNING COMMISSION, December, 1977. *Baggs Land Use Plan* (Amended March, 1979)
- BAGGS, WY., PLANNING COMMISSION, March, 1979. *Baggs Town Development Code*.
- BATES, V.E., 1978. "The Impact of Energy Boom-town Growth on Rural Areas" *Social Casework* pp. 73-82.
- BAUER, D.P., STEELE, T.D., and ANDERSON, R.D., 1978. "Analysis of Waste-Load Assimilative Capacity of the Yampa River, Steamboat Springs to Hayden, Routt County, Colorado" *U.S. Geological Survey Water Resources Investigation* 77-119.
- BENG, W.A., 1975. "Revegetation of Land Disturbed by Surface Mining in Colorado" Unpublished document held by author. Colorado State University, Agronomy Department, Ft. Collins, Colorado.
- BISHOP, M.; KELLY, K.; KIMBALL, D.; QUINN, G., 1982. *Cumulative Hydrologic Assessment: Effect of Coal Mining on the Yampa River Basin, Moffat and Routt Counties, Colorado* Denver: Kaman Tempo.
- BOETTCHER, A.J., 1972. "Groundwater Occurrence in Northern and Central Parts of Western Colorado" *Colorado Water Conservation Board, Water Resources Circular 15*.
- BRADFORD, GEORGE, 1976. "Paleo Points, an Illustration Chronology of Projectile Points." *Bradford Press*, Ontario, Canada.
- BRADLEY, W.A., 1964. "Geology of Green River Formation and Associated Eocene Rocks in Southwestern Wyoming and Adjacent Parts of Colorado and Utah" *U.S. Geological Survey Professional Paper 496-A*
- BRINTON, C.J., 1983. Manager, Environmental and Natural Resource Planning. Union Pacific Railroad Co. Omaha, NE., personal communication by Dave Cooper.
- BROGDEN, R.E. and GILES, T.F., 1977. "Reconnaissance of Groundwater Resources in a part of the Yampa River Basin between Craig and Steamboat Springs, Moffat and Routt Counties, Colorado" *U.S. Geological Survey, Water Resources Division, Water Resources Investigation* 77-4.
- BURBANK, W.A.; LOVERING, T.S.; GODDARD, E.N.; and ECKEL, E.B. "Geologic Map of Colorado" U.S. Geological Survey in cooperation with Colorado State Geological Survey Board and Colorado Metal Mining Fund, 1935 (Reprinted 1967.)
- BUREAU OF ECONOMIC ANALYSIS, REGIONAL ECONOMIC INFORMATION SYSTEM, 1982. *BEA Farm Income and Expenditures*. U.S. Department of Commerce. Washington.
- BUREAU OF THE CENSUS, 1982. *1980 Census of the Population*. U.S. Department of Commerce. Washington
- BUREAU OF LAND MANAGEMENT, 1976. *Final Environmental Statement, Northwest Colorado Coal* U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, 1978. *Environmental Assessment, Coal Lease Applications C-22644, C-26913, and C-22676*. Report #CO-010-9-34. Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, 1978a. *Final Environmental Statement, Development of Coal Resources in Southwestern Wyoming*.
- BUREAU OF LAND MANAGEMENT, 1978b. *Final Environmental Impact Statement, Development of Coal Resources in Southcentral Wyoming*.
- BUREAU OF LAND MANAGEMENT, 1978c. *Southwestern Wyoming Coal Environmental Statement*. Washington: USDI.
- BUREAU OF LAND MANAGEMENT, 1979a. *Final Environmental Statement, FEderal Coal Management Program* U.S. Department of the Interior; U.S. Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, 1979b. *Final Environmental Statement: Proposed Development of Coal Resources in Westcentral Colorado* U.S. Department of the Interior; U.S. Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, 1979c. *Final Environmental Statement, Development of Coal Resources in Southcentral Wyoming* U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, 1980. *Green River-Hams Fork Final Environmental Impact Statement: Coal*. U.S. Department of the Interior. Washington.
- BUREAU OF LAND MANAGEMENT, 1980a. *Environmental Impact Statement: White River Resource Area Grazing Management*. Washington: USDI.
- BUREAU OF LAND MANAGEMENT. 1982. *Site-Specific Environmental Report Beans Springs Preference Right Lease Applications*. Rock Springs: Department of Interior.
- BUREAU OF LAND MANAGEMENT, 1982a. *Wyoming Big Game Population Data*. On file at Rawlins BLM District Office.
- BUREAU OF LAND MANAGEMENT, 1982b. *Site Specific Analyses--Green River-Hams Fork Round 2 Coal Tracts*.
- BUREAU OF LAND MANAGEMENT, 1982c. *Ranch Budgets for Southern Wyoming*. Unpublished data available in Rock Springs, Wyoming, District Office.
- BUREAU OF LAND MANAGEMENT, February 1983. *Federal Oil Shale Management Program Draft Environmental Impact Statement*.
- BUREAU OF LAND MANAGEMENT, BUREAU OF RECLAMATION, GEOLOGICAL SURVEY, 1975a. *Resource and Potential Reclamation Evaluation, Hanna Basin Study Site* EMRIA Report 2-1975, U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, BUREAU OF RECLAMATION, GEOLOGICAL SURVEY, 1975b. *Resource and Potential Reclamation Evaluation, Taylor Creek Study Site* EMRIA Report 3-1975, U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, BUREAU OF RECLAMATION, GEOLOGICAL SURVEY, 1976. *Resource and Potential Reclamation Evaluation, Foidel Creek Study Site* EMRIA Report 6-1976, U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, BUREAU OF RECLAMATION, GEOLOGICAL SURVEY 1981. *Lay Creek Study Area; Resource and Potential Reclamation Evaluations*. Denver: Bureau of Reclamation Report No. 20.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1974a. *Williams Fork Planning Unit Resource Analysis* U.S. Department of the Interior; Government Printing Office, Washington, D.C.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1974b. *Williams Fork Unit Resource Analysis* Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1979a. *Supplement to the Williams Fork Management Framework Plan, Land Use Decisions* U.S. Department of the Interior; Craig District Office, Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1979b. *Energy Fuels Environmental Assessment/Technical Examination* U.S. Department of the Interior; Unpublished document on file at Craig District Office, Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1979c. *Supplement to Williams Fork MFP: Land Use Decisions: Determination of Unsuitability for Coal Development* U.S. Department of the Interior; Unpublished document on file at Craig District Office, Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1979d. *Site-Specific Analysis for the Green River/Hams Fork EIS*

- Unpublished documents on file at Craig District Office, Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, CRAIG DISTRICT, 1980. *Preliminary Cumulative Analysis for the Green River/Hams Fork EIS* Unpublished document on file at the Craig District Office, Craig, Colorado.
- BUREAU OF LAND MANAGEMENT, RAWLINS DISTRICT, 1976a. *Unit Resource Analysis: Hanna-Medicine Bow Planning Unit* U.S. Department of the Interior, on file at the Rawlins District Office, Rawlins, Wyoming.
- BUREAU OF LAND MANAGEMENT, RAWLINS DISTRICT, 1976b. "Unit Resource Analysis, Overland Planning Unit" *BLM Manual* (1607) Rawlins, Wyoming.
- BUREAU OF LAND MANAGEMENT, Rawlins District. 1979. *Class I Historic Cultural Resource Inventory, Final Draft*. Unpublished document on file at the Rawlins District Office, Rawlins, Wyoming.
- BUREAU OF LAND MANAGEMENT, Rock Springs District. 1983. Personal communication with J. Dunder, Wildlife Biologist, Rock Springs, Wyoming.
- CALL, M. 1979. *Habitat Management Guides for Birds of Prey*. Denver: USDI BLM.
- CARBON COUNTY COUNCIL OF GOVERNMENTS, 1978. *Carbon County Land Use Plan* Rawlins, Wyoming.
- CARBON COUNTY COUNCIL OF GOVERNMENTS AND OTHERS, 1979. *Analysis, Needs Assessment and Mitigation Strategies for the Period 1978 Through 1985, Carbon County and Incorporated Municipalities* Rawlins, Wyoming: Carbon County Council of Governments.
- CARBON COUNTY, WYOMING, COMMISSIONERS, June, 1972. *The Carbon County Zoning Resolution of 1972*.
- CHALMERS, J.A. and ANDERSON, E.J., 1977. *Economic/Demographic Assessment Manual* Springfield, Va.: National Technical Information Service.
- CILL, J. (USFWS) Area Office Salt Lake City, Utah. Consultation for T and E plants, animals and fishes. Personal interview by Duane Johnson.
- COLORADO CATTLEMEN'S ASSOCIATION, 1980. Information on cattle numbers. Personal interview by Duane Johnson. Denver, Colorado.
- COLORADO DEPARTMENT OF AGRICULTURE, 1981. *Colorado Agricultural Statistics*. Denver.
- COLORADO DEPARTMENT OF HEALTH, 1974. *Water Quality Standards and Stream Classification*. Colorado Department of Health, Water Control Division.
- COLORADO DEPARTMENT OF HIGHWAYS, 1980. *Colorado Traffic Volume Study*.
- COLORADO DEPARTMENT OF HIGHWAYS, 1980. *Accidents and Rates on State Highways*.
- COLORADO DEPARTMENT OF HIGHWAYS, 1980. *Colorado State Highway Railroad Crossing Data*.
- COLORADO DEPARTMENT OF HIGHWAYS, 1978b. *State Rail Plan*.
- COLORADO DEPARTMENT OF HIGHWAYS, 1979a. *Highway Capacities for Colorado at Level of Service C*, computed by Richard Cutler,
- COLORADO DEPARTMENT OF LOCAL AFFAIRS, DIVISION OF ENERGY AND MINERAL IMPACT, 1980. *Third Annual Report to the Colorado State Legislature, Summary and Status Report of the Mineral Lease and Severance Tax Fund* Denver, Colorado: Department of Local Affairs.
- COLORADO DEPARTMENT OF LOCAL AFFAIRS, 1979. *Division of Planning. Colorado Population Reports*, Series CP-26, No. 79 (A)-1. Denver, Colorado: Colorado Department of Local Affairs.
- COLORADO DEPARTMENT OF LOCAL AFFAIRS, 1980. *Third Annual Report to the Colorado General Assembly 1980: Summary and Status Report of the Mineral Lease and Severance Tax Fund*.
- COLORADO DEPARTMENT OF NATURAL RESOURCES, 1976. Technical Manual No. 1. *Manual for Estimating Flood Characteristics of Natural-Flow Streams in Colorado*. Prepared in cooperation with the U.S. Geological Survey, Jerald F. McCain and Robert D. Jarrett.
- COLORADO DEPARTMENT OF REVENUE, 1982. *Annual Report 1982*. Denver.
- COLORADO DIVISION OF WILDLIFE, 1977. *Today's Strategy...Tomorrow's Wildlife* Department of Natural Resources, Denver, Colorado.
- COLORADO DIVISION OF WILDLIFE, 1978. *Essential Habitat for Threatened or Endangered Wildlife in Colorado*. Denver: Department of Natural Resources.
- COLORADO DIVISION OF WILDLIFE, 1978a. *Colorado Reptile & Amphibian Distribution Latilong Study* Denver, Colorado.
- COLORADO DIVISION OF WILDLIFE, 1978b. *Colorado Mammal Distribution Latilong Study* Denver, Colorado.
- COLORADO DIVISION OF WILDLIFE, 1978d. *Essential Habitat for Threatened and Endangered Wildlife in Colorado* Denver, Colorado.
- COLORADO DIVISION OF WILDLIFE, 1980. Letter to H. Conley concerning deer and elk population densities. On file at Little Snake Resource Area, Craig BLM.
- COLORADO DIVISION OF WILDLIFE, 1981. *Small Game Harvest Statistics* Denver, Colorado.
- COLORADO DIVISION OF WILDLIFE, 1981. *Big Game Harvest Statistics* Denver (Published each year.)
- COLORADO DIVISION OF WILDLIFE, 1983. Letter to H. Conley concerning big game management units and populations. On file at Little Snake Resource Area, Craig BLM.
- COLORADO SCHOOL OF MINES RESEARCH INSTITUTE AND ENGINEERING ENTERPRISES, INC., 1976. "Mineralogy of Overburden as Related to Groundwater Degradation in the Strip Mining of Coal" (*Interim Progress Report, Colorado School of Mines, Golden, Colorado*.)
- COLORADO STATE UNIVERSITY, 1979. *Fishes and Microinvertebrates of the White and Yampa Rivers, Colo.* Department of Fishing and Wildlife Biology.
- COLORADO STATE UNIVERSITY, 1979. *Agriculture Statistics for Colorado and Wyoming*.
- COLORADO WATER CONSERVATION BOARD AND U.S. DEPARTMENT OF AGRICULTURE, 1969. *Water and Related Land Resources, Yampa River Basin in Colorado and Wyoming*. Colorado Water Conservation Board, Denver, Colorado.
- Colorado West Area Council of Governments. "Community Development Facilities Needs" (Questionnaire form.)
- COLORADO WOOLGROWERS ASSOCIATION, 1980. Information on sheep numbers. Personal interview by Duane Johnson. Denver, Colorado.
- COOK, C.W.; Taylor, (xi) and Bartlett, E.T. 1980. *Impacts of Federal Range Forage on Ranches and Regional Economics of Colorado*. Colorado State University Experiment Station Bulletin 5765. Fort Collins, CO.
- CORTESE, C.F., 1979. "Rapid Growth and Social Change in Western Communities" *Social Impact Assessment No. 4, Vol. 41, April-May*.
- CORTESE, C.F., and JONES, B., 1977. "The Sociological Analysis of Boom Towns" *Western Sociological Review*, Vol. 8, No. 1 n.p.
- COSELLO, J., 1982 U.S. Forest Service, Routt National Forest, Steamboat Springs, Colorado. Personal interview by David Cooper
- CRAMER, H. BOWERS, J., and SATERLIE, S.F., 1978. *Calculated Impacts of the Proposed Emery Power Plant Expansion*. Prepared for Utah Power and Light Company, Salt Lake City, Utah, by H.E. Cramer Company. TR-78-44901.
- CREASMAN, S.D., 1979. *Archaeological Investigations in the Canyon Pintado Historic District, Rio Blanco County, Colorado*, Reports of the Laboratory of Public Archaeology No. 34. Colorado State University, Ft. Collins, Colorado.
- CUMBERLAND COAL COMPANY, 1981. *Mine Plan for South Haystack Mine*; Appendix D6-Hydrology.
- DAIN BOSWORTH, INC., 1980. *Financial Facts on Wyoming Taxing Units*, 1980 Edition. Minneapolis.

- D'AZEVEDO, W.L., W.D. Davis, D.D. Fowler, W. Suttles editors, 1964. *The Current Status of Anthropological Research in the Great Basin: 1964*. Desert Research Institute, Technical Report Series S-H, Social Sciences and Humanities publication no. 1 Reno, May 1966.
- DeLONG, L.L., No Date. *Water Quality of Streams and Springs, Green River Basin Wyoming* U.S. Geological Survey Water Resources Investigations 82-4008 in preparation.
- DEPARTMENT OF THE INTERIOR, 1983. *Quality of Water Colorado River Basin*, Progress Report No. 11.
- DIVISION OF LOCAL GOVERNMENT, undated. *1980 Local Government Financial Compendium*. Colorado Department of Local Affairs. Denver.
- DIVISION OF MINES, 1981. *A Summary of Mineral Industry Activities in Colorado 1980*. Department of Natural Resources. Denver.
- DIVISION OF PARTS AND OUTDOOR RECREATION, 1981. *Colorado Comprehensive Outdoor Recreation Plan*.
- DIVISION OF PROPERTY TAXATION, 1982. *Eleventh Annual Report*. Colorado Department of Local Affairs. Denver.
- DIXON, WYOMING, PLANNING COMMITTEE, N., 1977. *Dixon Land Use Plan 1977*.
- DOBBIN, C.E.; BOWEN, C.F.; and HOOTS, H.W., 1929. "Geology and Coal and Oil and Gas Resources of the Hanna and Carbon Basins, Carbon County, Wyoming" *U.S. Geol. Survey Bull.* 804, 68 p.
- DUNRUD, C. RICHARD, 1976. *Some Engineering Geologic Factors Controlling Coal Mine Subsidence in Utah and Colorado*. U.S. Geological Survey Pro. Paper 969. 39 p.
- EDSON, G.M., 1979. "Preliminary Geologic Map and Coal Sections of the Seaverson Reservoir Quadrangle, Carbon County, Wyoming" U.S. Geol. Survey Open-File Report 79-1577, 2 sheets.
- EFFECTS OF REDUCTIONS IN FEDERAL GRAZING PERMITS ON SHEEP RANCH. *Value and Borrowing Capacity*; CSU Experimental Stations, Fort Collins; Bulletin 5835.
- ELLENBERGER, J.H., 1979. Wildlife Biologist, Colorado Division of Wildlife, Grand Junction. Phone conversation with H. Conley, November 5.
- ELLENBERGER, J.H., 1980a. Wildlife Biologist, Colorado Division of Wildlife, Grand Junction. Phone conversation with R. Stark, March 28.
- ELLENBERGER, J.H., 1980b. Wildlife Biologist, Colorado Division of Wildlife, Grand Junction. Letter concerning deer and elk populations received by Herb Conley.
- ELK MOUNTAIN, WYOMING, PLANNING COMMISSION, 1976. *Elk Mountain, Wyoming, General Plan*.
- ELMO, WYOMING, PLANNING COMMISSION, 1977. *Comprehensive Land Use Plan, Elmo, Wyoming*.
- ENCAMPMENT, WYOMING, PLANNING COMMISSION, 1977. *Encampment Land Use Plan*.
- ENERGY FUELS CORPORATION, 1979. *Mine Plan for Energy Fuels Mine #1 and #2*, Routt County, Colorado.
- ENERGY FUELS CORPORATION, 1980. *Salt Load Study*, unpublished, 1980.
- FEDERAL REGISTER, 1980. "Wetland Riparian Area Protection and Management; Policy and Protection Procedures; Final Guidelines" Washington, D.C.
- FINLEY, R., (USFWS) Denver Office Coal Coordinator. Consultation for T and E species. Personal interview by Duane Johnson.
- FLOODPLAIN MANAGEMENT: Executive Order 11988, in Federal Register, Vol. 42, No. 101, May 25, 1977. p 26951 26957.
- FOWLER, C.S., 1970. *Greent Basin Anthropology...A Bibliography*. Social Sciences & Humanities Publication No. 5. Western Studies Center. Desert Research Institute. University of Nevada System. Reno and Las Vegas, Nevada.
- FREUDENBURG, WILLIAM R. August 31, 1976. "The Social Impact of Energy Boom Development on Rural Communities: A Review of Literatures and Some Predictions" Paper prepared for ASA National Convention.
- FREUDENBURG, WILLIAM R., 1979a. *Boomtown's Youth* Paper presented at the 1979 annual meeting of the Rural Sociological Society, Burlington, Vermont, August 23-26.
- FREUDENBURG, WILLIAM R. 1979b. "An Ounce of Prevention : Another Approach to Mitigating the Human Problems of Boomtowns" *Energy Resource Development: Implications for Women and Minorities* U.S. Commission on Civil Rights, Washington, D.C.
- FREUDENBURG, WILLIAM R., Aug., 1981. "The Social and Economic Impacts of Oil Shale Development: Research to Support Decisions." Paper prepared for the Conference, "Oil Shale: The Environmental Challenges II," Vail, Colorado. Scientific Paper, Project 0478, College of Agriculture Research Center, Washington State University.
- FREUDENBURG, WILLIAM R., January, 1982. "The Social and Economic Impacts of Major Developments in the West: An Overview." Paper prepared for the annual meetings of the American Association for the Advancement of Science, Washington, D.C., January 4-8, 1982. Scientific Paper, Project 0478, College of Agriculture Research Center, Washington State University.
- FREUDENBURG, W.R., AND OTHERS, 1977. "Subjective Responses to an Energy Boomtown Situation: A Preliminary Report on Research in Progress in Four Western Colorado Towns" Paper prepared for ASA 72nd Annual Meeting.
- FRICKEL, D.G., L.M. Shown, R.F. Hadley, and R.F. Miller, 1981. *Methodology for Hydrologic Evaluation of a Potential Surface Mine: The Red Rim Site. Carbon and Sweetwater Counties, Wyoming*, Denver: U.S. Geological Survey Open-file Report 81-75.
- FRISON, G.C., 1978. *Prehistoric Hunters of the High Plains* Academic Press.
- GALE, H.S., 1907. *Gold Placer Deposits Near Lay, Routt County Colorado*. USGS Bulletin 340 Contributions to Economic Geology, Part 1, 1907.
- GALE, H.S., 1907a. *Coal Fields of the Danforth Hills and Grand Hogback in Northwestern Colorado* U.S. Geological Survey Bulletin 316-E, pp. 264-301.
- GALE, H.S., 1909. *Coal Fields of Northwestern Colorado and Northeastern Utah* U.S. Geological Survey Bulletin 341-C, pp. 283-315.
- GALE, H.S., 1910. *Coal Fields of Northwestern Colorado and Northwestern Utah* U.S. Geological Survey Bulletin 415.
- GILL, J.R.; MEREWETHER, E.A.; and COBBAN, W.A., 1970. "Stratigraphy and Nomenclature of Some Upper Cretaceous and Lower Tertiary Rocks in Southcentral Wyoming" *U.S. Geologic Survey Professional Paper* 667 53 p.
- GILMORE, J.S. AND DUFF, M.K., 1974. *The Sweetwater County Boom: A Challenge to Growth Management* Denver Research Institute, Denver, Colorado.
- GILMORE, J.S. AND OTHERS, 1976. *Analysis of Financing Problems in Coal and Oil Shale Boom Towns* Springfield, Virginia: National Technical Information Service.
- GILMORE, J.S., 1976. "Boom Towns May Hinder Energy Resource Development" *Science*, Vol. 191, pp. 535-540.
- GILMORE, J.S. AND OTHERS, 1977. *Socioeconomic Impact Mitigation Mechanisms in Six States--Categories, Generalizations and Unresolved Issues* Denver, Colorado: University of Denver and Bickert, Browne, Coddington, and Associates.
- GOLD, R. L., 1976. "Social and Socioeconomic Aspects of Coal Development in Our Part of the Nation" Paper presented to North Dakota Wildlife Federation, Bismarck, North Dakota.
- GORDON AND KRANZUSH, 1982. *A Class II Cultural Inventory of the Lower White River and Danforth Hills Know Recoverable Coal Resource Areas, Moffat and Rio Blanco counties, Colorado*. Copy on file BLM, Little Snake Resource Area, Craig District, Craig, CO.
- GRADY, J., 1980. *Environmental Factors in Archeological Site Locations Piceance Basin, Colorado*. Bureau of Land Management Colorado Cultural Resources Series No. 9.

- HADLEY, R.F., AND SCHUMM, S.A., 1961. "Sediment Sources and Drainage-Basin Characteristics in Upper Cheyenne River Basin; Hydrology of Upper Cheyenne River Basin" U.S. Geological Survey Water Supply Paper 1531. HANCOCK, E.T., 1925. *Geology and Coal Resources of the Axial and Monument Butte Quadrangle, Moffat County, Colorado* U.S. Geological Survey Bulletin 757.
- HANCOCK, E.T., AND EBY, J.G., 1930. *Geology and Coal Resources of the Meeker Quadrangles, Moffat and Rio Blanco Counties, Colorado*. U.S. Geological Survey Bulletin 812-C, pp. 191-242.
- HANNA, WYOMING, PLANNING COMMISSION, 1977. *Hanna Land Use Plan Policies*.
- HANSON, MARY, 1983. Outdoor Recreation Planner. USDI BLM, Rock Springs, Wyoming. Personal Communication by Dave Cooper.
- HAUN, J.D., 1962. *Introduction to the Geology of Northwest Colorado. i n Exploration for Oil and Gas in Northwest Colorado*, C.L. Amuedo and M.R. Mott, eds: Denver, Colorado, Rocky Mountain Association of Geologists, p. 7-14.
- HERITAGE CONSERVATION AND RECREATION SERVICE, December 1979. *The Third Nationwide Outdoor Recreation Plan*.
- HITCHCOCK, A.S., 1950. *Manual of Grasses of the U.S.* Washington, D.C.: U.S. Government Printing Office.
- HORNBAKER, A.L., Holt, R.D., and Murran, D.K., 1976. *Summary of Coal Resources in Colorado, 1975*. Colorado Geological Survey Special Publications 9, 17 p.
- IRONS, W.V.; HEMBREE, C.H.; AND OAKLAND, G.L., 1965. "Water Resources of the Upper Colorado River Basin--Technical Report" U.S. Geological Survey Professional Paper 441.
- JENNINGS, JESSE D., 1980. *Ancient Native Americans*. Freeman & Company, San Francisco
- JIM BRIDGER MINE BASE DOCUMENT: *Reclamation Plan, Unsuitable Overburden and Interburden Material*; RP-30, 7/22/81.
- JOBES, P.C., 1976. "Practical Problems Facing Sociologists Preparing Environmental Impact Statements" *Social Impact Assessment, No. 8, August*
- JOHN MUIR INSTITUTE, n.d. *Various Routine Seasonal Visibility Reports*. Fort Collins, Colorado
- JONES, K.T., 1978. *Archaeological Investigations at the Three-mile Gulch Site, Rio Blanco County, Colorado*. Reports of the Laboratory of Public Archaeology, No. 20. Colorado State University, Ft. Collins, Colorado.
- KAMAN TEMPO REPORT: *Cumulative Hydrologic Assessments, Effects of Coal Mining on Coal Mining on the Yampa River Basin, Moffat and Routt Counties, Colorado*. 1982.
- KASSOVER, J., AND MCKEOWN, R.L., n.d. "Toward a Sense of Community in the Modern Boom Town" Boom Towns: Managing Growth AMAX, Inc., 4704 Harlan Street, Denver, Colorado 80212, AIME Series No. 79-01, pp. 49-55.
- KRULL, O.W., 1902. *Report on the Blomide Copper Group*. Copy on file at Bureau of Land Management Little Snake Resource Area Office, Craig, Colorado.
- LANTZ, A., AND MCKEOWN, R.L., 1979. "Social/Psychological Problems of Women and Their Familiar Associated with Rapid Growth" *Energy Resource Development: Implications for Women and Minorities in the Intermountain West* U.S. Commission on Civil Rights, Washington, D.C., U.S. Printing Office.
- LARSON, DOUG, 1982. Resource Staff Officer U.S.D.A. Medicine Bow National Forest, Laramie Wyoming. Personal Communication by Dave Cooper.
- LARSON L.R. and Zimmerman E.A. 1981. *Water Resources of Upper Separation Creek Basin, South-Central Wyoming* Cheyenne: U.S. Geological Survey Water-Resource Investigations 80-85.
- LEAVESLY, G.S., Sr., Lichty, R.W., Troutman, B.M., Saindon, L.G., 1982, *Precipitation--Runoff Modeling System*; U.S. Geological Survey, Users Manual, Water Resources Investigation, 245 pages.
- LILLYDAHL, ET AL., 1982. *Quality of Life, Expectations, and Planning for the Future in an Energy Production Community*. Boulder, Colorado: Institute of Behavioral Research, University of Colorado.
- LITTLE, R.L. 1978. "Energy Boom Towns: Views From Within" *In Native Americans and Energy Development* ed. Jorgenson, Joseph, et al., Anthropology Resource Center, P.O. Box 90, Cambridge, Mass. 02138
- LONG, GARY, 1983. Bureau of Land Management. Rawlins, Wyoming. Personal Communication by Dave Cooper.
- LOWHAM, H.W., 1976. *Techniques for Estimating Flow Characteristics of Wyoming Streams*. Cheyenne: U.S. Geologic Survey Water-Resources Investigations 76-112.
- LOWHAM, H.W., 1982. *Streamflows and Channels of the Green River Basin, Wyoming*. Cheyenne: U.S. Geological Survey Water-Resources Investigations 81-71.
- LOWHAM, H.W., L.L. DeLONG, K.R. Collier, and E.A. Zimmerman, 1982. *Hydrology of Salt Wells Creek - A Plains Stream in Southwestern Wyoming*. Cheyenne: U.S. Geologic Survey Water Resource Investigations 81-62.
- LOWRY, M.E.; RUCHER, J.J. IV.; AND WAHL, K., 1973. "Water Resources of the Laramie, Shirley, Hanna Basins and Adjacent Areas, Southeastern Wyoming" U.S. Geol. Survey Hydrologic Invest. Atlas HA-471, 4 sheets.
- LUCAS, S.G., and Kihm, A.J., 1982. *Paleontological Resource Study and Inventory of Part of the White River Resource Area and Vicinity, Piceance Creek Basin, Northwestern Colorado*: Bureau of Land Management; Craig District, prepared by ESCA-Tech Corp. contract YA-553-CT1-129.
- MARGOLIS, E., n.d. *A Social-Economic Profile of the Tri-County Area of Northwest Colorado* Bureau of Land Management, Craig District Office, Craig, Colorado.
- MAURA, WENDY S, 1982. *Water-Quality Data for Streams in the Southern Yampa River Basin, Northern Colorado*. U.S. Geological Survey Open File Report 82-1017.
- McKEAN, J.R. and Nobe, K.C., 1983. *Sportsman Expenditures for Hunting and Fishing in Colorado, 1981*. Tech. Report #39, Colorado State University, Fort Collins, Colorado.
- McKEAN, J.R. and Weber, J.C., 1981. *The Economy of Albany, Carbon, and Sweetwater Counties, Wyoming*. Colorado State University, Fort Collins, Colorado.
- McKEAN, J.R. and Weber, J.C., 1983a. *The Economy of Albany, Carbon, and Fremont Counties, Wyoming*. Colorado State University, Fort Collins, Colorado.
- McKEAN, J.R. and Weber, J.C., 1983b. *The Economy of Lincoln, Sublette, Sweetwater, and Uinta Counties, Wyoming*. Colorado State University, Fort Collins, Colorado.
- McWHORTER, D.B. et al., 1979. *Surface and Subsurface Water Quality Hydrology in Surface Mined Watersheds*, EPA 600/17-79-193a.
- McWHORTER, D.B. AND SKOGERBOE, R.K., 1975. *Surface and Subsurface Water Quality Hydrology in Mine Spoils*. Second Quarterly Progress Report for EPA Grant No. R803175-01-02, Colorado State University, Ft. Collins, Colorado.
- McWHORTER, D.B., J.W. Rowe, M.W. Van Liew, R.L. Chandler, R.K. Skogerboe, D.K. Sunada, and G.V. Skogerboe, 1979. *Surface and Subsurface Water Quality Hydrology in Surface Mined Watersheds*, EPA Pub. 600/7-790-193a.
- METCALF, M.D., 1975. *Archaeological Investigations at the Black Butte Mine, Sweetwater County, Wyoming* Black Butte Coal Col., Point of Rocks, Wyoming.
- METCALF, M.D., Ed. 1977. "An Archaeological Sampling Survey of the Sweetwater-Kemmerer and Hanna-Atlantic Rim Coal ES Areas" *Occasional Papers NO. 10* Western Wyoming College, Rock Springs, Wyoming.
- MEURER, SERAFINI AND NEURER, INC., 1978. *City of Rawlins, Wyoming, Master Plan Phase 1: Community Development Analysis and Guidelines*.
- MILLER, A.E., 1975. *Geologic, Energy and Minerals Resources Maps of Routt County, Colorado* Geological Survey, Map Series 1.

- MILLER, BOB, 1982. USDA White River National Forest, Glenwood Springs, CO. Personal communication by Dave Cooper.
- MOEN, E., et al., April, 1979. *Women and Energy Development: Impact and Response* University of Colorado, Institute of Behavioral Science, Boulder, Colorado.
- MOEN, ELIZABETH W., 1983. "Community Satisfaction." Boulder, Colorado: Growth Impact Group, Program on Population Processes, Institute of Behavioral Science, University of Colorado.
- MOFFAT COUNTY BOARD OF COMMISSIONERS, 1972. *Moffat County Subdivision Regulations* (Amended April, 1973.)
- MOFFAT COUNTY BOARD OF COMMISSIONERS, 1978. *1978 Revised Moffat County Zoning Resolution* (Amended August, 1979.)
- MOUNTAIN PLAINS FEDERAL REGIONAL COUNCIL, 1979. *Federal Assistance for Energy Impacted Communities* Denver, Colorado: Mountain Plains Federal Regional Council.
- MOUNTAIN WEST RESEARCH, INC., 1975. *Construction Worker Profile* Old West Regional Commission, Fratt Building, Billings, Montana 59101, 10 vols.
- MOUNTAIN WEST RESEARCH - Southwest, Inc., undated. *Description of the Mountain West Planning and Assessment System*. Tempe, AZ.
- MURRAY, R.A., 1976. "Historic Resources Data, Sweetwater/Kemmerer and Hanna/Atlantic Rim Coal Studies" Unpublished Manuscript. Cheyenne, Wyoming: Bureau of Land Management, U.S. Department of the Interior.
- MURRAY, R.A., 1979a. "Final Draft, Class I Historic Cultural Resource Inventory for the Rock Springs, Wyoming District" Unpublished Manuscript, 2 Volumes. Rock Springs, Wyoming: Bureau of Land Management, U.S. Department of the Interior.
- MURRAY, R.A., 1979b. "Final Draft, Class I Historic Cultural Resource Inventory for the Rawlins (Wyoming) District" Unpublished Manuscript, 2 Volumes. Rawlins, Wyoming: Bureau of Land Management, U.S. Department of the Interior.
- MURRAY, F.X., ed. 1978. *Where We Agree: Report of the National Coal Policy Project* Westview Press, Boulder, Colorado.
- MURRY, D.K. 1981. *Upper Cretaceous (Campanian) Coal Resources of Western Colorado, in Western Slope Colorado*, R.C. Epis and J.F. Callender, eds: New Mexico Geological Society 1981 field Conference Guide Book, p. 233-239.
- NATIONAL ACADEMY OF SCIENCES, 1974m. *Rehabilitation Potential of Western Coal Lands*, Ballinger Publishing Co.; Cambridge, Mass.
- NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, 1978. *Climates of the States*. Volumes 1 and 2: Alabama-Wyoming, Puerto Rico, Virgin Islands. Gale Research, Detroit, Michigan.
- NATURAL RESOURCE ECOLOGY LABORATORY, n.d. *National Atmospheric Deposition Program - Quarterly Reports*. Fort Collins, Colorado.
- NERCO, INC., 1981. *Mine Plan for Bridger Coal Company Jim Bridger Mine*. Portland: Jim Bridger Mine Base Document.
- OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT, 1982. *Proposed Mining and Reclamation Plan, Meeker Area Mines, Rio Blanco County, Colorado*. Denver: Office of Surface Mining. Western Technical Center.
- OLSON, P.D., 1980. Colorado Division of Wildlife, Regional Manager, Grand Junction. Letter on deer and elk populations to Herb Conley.
- ORTON, R.H., 1977. *Comprehensive Plan for the Craig Area of Moffat County*.
- PACIFIC SOCIOLOGICAL REVIEW, vol. 25, no. 3 July, 1982, entire issue: "Social Research on Boom Towns: Debate."
- PACIFIC SOUTHWEST INTER-AGENCY COMMITTEE, 1968. *Factors Affecting Sediment Yield in the Pacific Southwest Area*. (Report of the Water Management Subcommittee, Sedimentation Task Force, PSIAC, U.S. Department of Interior.)
- PARKER, R.S. 1983. *Simulated Effects of Anticipated Coal Mining on Dissolved Solids in Selected Tributaries of the Yampa River*, Northwestern Colorado, Water-Resources Investigation Report 83-4084 USGS.
- PEDCO ENVIRONMENTAL, 1981. *Colorado's Climate, Meteorology and Air Quality*. Prepared for U.S. Department of the Interior, Bureau of Land Management under Contract No. YA-553-CTO-09. Cincinnati, Ohio.
- PIPIRINGOS, G.N., 1968. *Correlation and Nomenclature of Some Triassic and Jurassic Rocks in Southcentral Wyoming*: U.S. Geol. Survey Prof. Paper 594-D, 26 p.
- PROSPECT POINT COAL COMPANY. 1980. *Leucite Hills Mine Plan: Appendix D-ba Rock Springs*: Rocky Mountain Energy.
- PUBLIC LAW 93-205, 93rd CONGRESS, 1973. *Endangered Species Act of 1973* December 28, 1973.
- PUSTMUELLER, C., 1980. Director Colorado Natural Areas Program, Department of National Resources. 1313 Sherman Street, Room 718, Denver, Colorado. Consultation for T and E plants in study regions. Personal interview by Duane Johnson.
- QAYYUM, M.A., AND KEMPER, W.D., 1962. "Salt-Concentration Gradients in Soils and Their Effects on Moisture Movement and Evaporation" *Soil Science*, Vol. 93, No. 5.
- RADIAN CORPORATION, 1983a. *Various Site Specific Air Quality Impact Analyses for Proposed Lease Tracts in the Green River/Hams Fork Study area*. Prepared for U.S. Department of the Interior, Bureau of Land Management under Contract No. YA-553-CT2-61. Austin, Texas.
- RADIAN CORPORATION, 1983b. *Technical Report on Climate and Air Quality for the Green River/Hams Fork Round II Coal Leasing EIS*. Prepared for U.S. Department of the Interior, Bureau of Land Management under Contract No. YA-553-CT2-61. Austin, Texas.
- RAHN, P.H., 1975. *Potential of Coal Strip Mine Fills as Aquifers in the powder River Basin*. Quarterly Progress Report and Assessment and Evaluation of Work Completed to Date Engineering and Mining Experiment Station, South Dakota School of Mines and Technology, Rapid City, South Dakota.
- REED, D.F., 1978. Colorado Division of Wildlife, Wildlife Researcher, Glenwood Springs. Letter on animal-vehicle collisions to Herb Conley.
- RENICK, B.C., 1929. *Geology and Ground-Water Resources of Central and Southern Rosebud County, Montana with Chemical Analyses of the water* by H.B. Riffenburg. U.S. Geological Survey Water Supply Paper 600.
- RIGBY, J.K., JR., 1976. "Geologic Setting and Mammalian Fauna of Sqain Quarry, Middle Paleocene (Torreionian), Carbon County, Wyoming" Columbia University, New York, Ph. D. Thesis (unpublished).
- RIO BLANCO COUNTY PLANNING COMMISSION, 1976. *Master Plan - Rio Blanco County*.
- RIVERSIDE, WYOMING, PLANNING COMMISSION, 1977. *Riverside Land Use Plan*.
- ROCKY MOUNTAIN ENERGY, 1980. *Leucite Hills Mine--Mining and Reclamation Plan*.
- ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION, 1979. *The Mitigation Symposium: A National Workshop on Mitigating Losses of Fish and Wildlife Habitats* U.S. Department of Agriculture, Forest Service, Ft. Collins, Colorado.
- ROEHLER, H.W., 1973. *Mineral Resources in the Washakie Basin, Wyoming, and Sand Wash Basin, Colorado*. Wyoming Geological Association Guidebook 25th Field Conference. pp. 47-56.
- ROOT, F.K., Glass, G.B., and Lane, D.W., 1973. *Sweetwater County, Wyoming. Geologic map, Atlas, and Summary of Economic Mineral Resources*. Wyoming Geological Survey, County Resource Series No. 2.

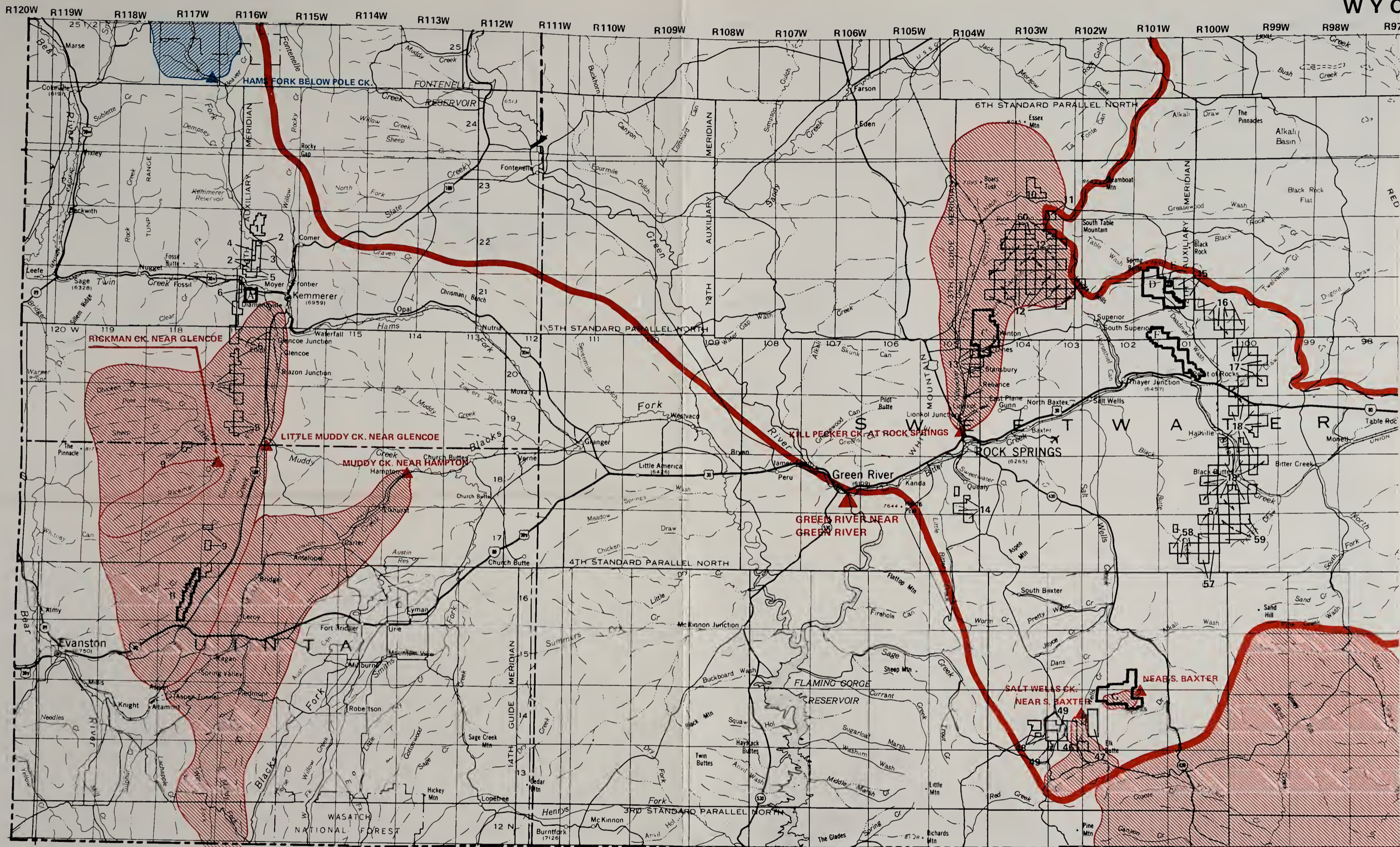
- ROUTT COUNTY REGIONAL PLANNING COMMISSION, 1979. *Oak Creek and Yampa, Colorado, Housing Study* Steamboat Springs, Colorado.
- ROUTT COUNTY REGIONAL PLANNING COMMISSION, 1972. *Route County Comprehensive Plan, Statement of Policy, and portions of Route County Zoning Resolution.*
- ROWE, J.W. AND McWHORTER, D.B., 1978. Salt Loading in Disturbed Watershed-Field Study. *Journal of the Environmental Engineering Division, Proceedings of the American Society of Civil Engineers, Vol. 104, No. EE2.*
- ROWLEY, P.W., Tweto, Ogden, Hansen, W.R., and Carrara, P.E., 1979. *Geologic map of the Vernal 1x2 Quadrangel, Colorado, Utah, and Wyoming.* U.S. Geological Survey. Map MF-1163.
- SANDERS, R.B., 1974. "Geologic Map and Coal Resources of the Riner Quadrangel, Carbon and Sweetwater Counties, Wyoming." *U.S. Geol. Survey Coal Inv. Map C-68.*
- SARATOGA, WYOMING, PLANNING COMMISSION, 1977. *Saratoga Land Use Plan.*
- SCHLER, JON, 1983. Colorado Department of Local Affairs, Grand Junction, CO. Personal interview by Dave Cooper.
- SCIBELLI, A., 1980. Council of Government, Carbon County, Rawlins, Wyoming. Personal interview by Robert Divine.
- SCIENCE APPLICATIONS, INC., 1980. *Baseline Climate and Air Quality for BLM Lands in Wyoming.* Prepared for U.S. Department of the Interior, Bureau of Land Management. La Jolla, California.
- SEDGLEY, E.F., n.d. *Revegetation Potential of Western Rangelands in the Oil Shale Region;* USDA, Soil Conservation Service, Denver, Colorado.
- SHARROCK, F.W., 1966. "Prehistoric Occupation Patterns in Southwest Wyoming and Cultural Relationships With the Great Basin and Plains Culture Areas" *University of Utah Anthropology Papers No. 77* University of Utah, Salt Lake City, Utah.
- SHELL, G.D., 1901. *Report of the Bromide Copper Group.* Copy on file at Bureau of Land Management Little Snake Resource Area Office, Craig, Colorado.
- SHELTON, D.C. and PROUTY, DICK, 1979. *Nature's Building Codes-geology and Construction in Colorado.* Colorado Department of Natural Resources, Colorado Geological Survey, Special Publication 12. 72 p.
- SINCLAIR, WYOMING, PLANNING COMMISSION, 1977. *Comprehensive Land Use Plan,* Sinclair, Wyoming.
- SLATKAVITZ, ROY C., 1983. USDI National Park Service Rocky Mountain Regional Office, Division of Park Planning. Denver, CO. Personal Communication by Dave Cooper.
- SNOW, C., 1974. *Habitat Management Series for Unique or Endangered Species - Ferruginous Hawk.* Denver: USDI BLM.
- SNOW, E.P., 1895. *The Four Mile Placer Field of Colorado and Wyoming.* The Engineering and Mining Journal Vol. 60 No. 5: 102-105.
- SOIL CONSERVATION SERVICE AND COLORADO STATE UNIVERSITY, 1979. *Important Farmlands of Rio Blanco County* U.S. Department of Agriculture.
- STEEL, T.D., BAUER, D.P., WENTZ, D.A., and WARNER, J.W., 1979. "The Yampa River Basin, Colorado and Wyoming--A Preview to Expanded Coal-Resource Development and Its Impacts on Regional Water Resources" *U.S. Geological Survey Water Resources Investigations 78-126.*
- STEENHOF, K., 1978. *Management of Wintering Bald Eagles.* Washington: U.S. Government Printing Office.
- STEWART, J.H., 1938. Basin-Plateau Aboriginal Sociopolitical Groups. *Bureau of American Ethnology Bulletin B.A.B. 120* Washington, D.C.
- SUNLAND MINING CORPORATION, 1981. *Mine Plan for Apex No. 2 Mine,* Oak Creek, Colorado.
- SWAIN, B.W., 1957. *Fort Union Formation, West Flank of Sierra Madre, Carbon County, Wyoming;* University of Wyoming, Laramie, Master's Thesis (unpublished).
- SWEETWATER COUNTY ASSOCIATION OF GOVERNMENTS, 1981. *Sweetwater County Housing Plan, Sweetwater County, Wyoming.*
- SWEETWATER COUNTY, WYOMING, BOARD OF COMMISSIONERS, 1977. *Subdivision Regulations of Sweetwater County, Wyoming.*
- SWEETWATER COUNTY, WYOMING, BOARD OF COMMISSIONERS, 1979. *Zoning Resolution of Sweetwater County, Wyoming.* (Amended February, 1980.)
- SYSTEMS APPLICATIONS, INC., 1982. *Draft Air Quality Technical Report for the Uintah Basin Synfuels Development Environmental Impact Statement.* Prepared for U.S. Department of the Interior, Bureau of Land Management under Contract No. YA-553-CT1-1098. San Rafael, California.
- TABLER, RONALD, 1975. "Surface Environment and Mining in the West" *User Guide to Hydrology for Mining and Reclamation in the West* University of Wyoming, Laramie, Forest Range and Watershed Laboratory; U.S. Department of Agriculture, Forest Service.
- TERRA GRAPHICS, 1976. *Oil and Gas Production Map of the Rocky Mountain Region.* Denver, Colorado.
- THK ASSOCIATES, INC., 1976. *Housing in Sweetwater County.*
- THK ASSOCIATES, INC., 1977. *Final Land Use Plan, Sweetwater County, Wyoming* (Amended November, 1977.)
- THK ASSOCIATES, INC., 1979. *Population Projection 1979-1990, Sweetwater County, Wyoming,* Annual Update.
- THK ASSOCIATES, INC., 1980. Update 1979: *Land Use and Housing, Sweetwater County, Wyoming.*
- TIERNEY, PATRICK, 1980. Environmental Research and Technology, Inc. *The 1980 Colorado Whitewater Boating Use and Economic Impact Study.*
- TIMBERLAKE, 1983. Director of Unit Train Operations. Denver and Rio Grande Western Railroad. Denver, CO. Personal interview by Dave Cooper.
- TREFETHEN, J.B., 1964. *Wildlife Management and Conservation.* Boston: D.C. Heath and CO.
- TURK, J.T., 1982. Project Chief, Water Resource Division, U.S. Geological Survey. Personal Communication, Lakewood, Colorado.
- TURK, JOHN T. and RANDOLF S. Parker, 1982. *Water-Quality Characteristics of Six Small Semiarid Watersheds in the Green River Coal Region of Colorado.* U.S. Geological Survey Water Resources Investigations 81-19.
- TWETO, O., OGDEN., 1975. *Preliminary Geologic Map of the Craig 1-1/4 X 2-1/4 Quadrangel, Colorado* U.S. Geological Survey Open-File Map.
- TWETO, OGDEN, 1976. *Geologic map of the Craig 1x2 quadrangel, Northwestern Colorado.* U.S. Geological Survey. Map I-972.
- U.S. DEPARTMENT OF COMMERCE, June 1977. *Guidelines for Preparing Environmental Impact Statements on Noise.* National Technical Information Service. AD/A-044 384.
- U.S. DEPARTMENTS OF THE AIR FORCE, ARMY, AND NAVY, December 1976. *Planning in the Noise Environment* (Draft). Joint Technical Bulletin #AFR 19X, TM5-XXX, NAVFAC P-XX. Washington, D.C.
- U.S. ENVIRONMENTAL PROTECTION AGENCY, 1976. "Quality Criteria for Water" *U.S. Environmental Protection Agency Report EPA-440/9-76-023.*
- U.S. ENVIRONMENTAL PROTECTION AGENCY, 1977. *Steamboat Springs Regional Service Authority, 201 Wastewater Facilities Plan--Final Environmental Impact Statement.* U.S. EPA: Region VIII. Denver, Colorado. Prepared by Weiner and Associates. Report EPA-908/5-77-005.
- U.S. ENVIRONMENTAL PROTECTION AGENCY, 1978. *Action Handbook: Managing Growth in the Small Community, Part I, Getting a Picture of What's Ahead* EPA Report #EPA-908/4-78-005a. U.S. EPA, Region VIII, 1860 Lincoln Street, Denver, Colorado.
- U.S. DEPARTMENTS OF THE AIR FORCE, ARMY, AND NAVY. December 1976. *Planning in the Noise Environment* (Draft). Joint Technical Bulletin #AFR 19X, TM5-XXX, NAVFAC P-XX. Washington, D.C.

- U.S. FOREST SERVICE, 1979. *User Guide to Soils; Mining and Reclamation in the West*. USDA Forest Service; General Technical Report Int.-68. Ogden, Utah.
- U.S. FOREST SERVICE, 1979. *Proposed and Recommended Threatened and Endangered Plant Species of Forest Service Rocky Mountain Region*. U.S. Department of Agriculture; Forest Service Region Two; Lakewood, Colorado.
- U.S. FOREST SERVICE, August 1981. *Trends in Recreation Use of National Forest Wilderness*. Intermountain Forest and Range Experiment Station, Research Note INT-319.
- U.S. FOREST SERVICE, ROUTT NATIONAL FOREST, 1982. *Proposed Forest Management Plan and Draft Environmental Impact Statement*.
- U.S. Geological Survey, 1979. *Coal Resource Occurrence and Coal Development Potential Maps of the Lay SE Quadrangle*. Moffat County, Colorado USGS Open File Report 79-878.
- U.S. Geological Survey, 1980. *Effects of Coal Mine Subsidence in the Sheridan, Wyoming, Area*. Washington, D.C.: Geological Survey Professional Paper 1164.
- U.S. GEOLOGICAL SURVEY, 1981. *Water Resources Data for Wyoming, Water year 1980*. Cheyenne: U.S. Geological Survey Water Data Report WY-80-2
- U.S. GEOLOGICAL SURVEY, Water Resources Division, WATERSTORE Retrieval, November 25, 1981; April, 1982.
- UNIVERSITY OF IDAHO, 1976. *Proceedings of the Elk-logging--roads Symposium*. Moscow: Univ. of Idaho.
- UPLAND INDUSTRIES, 1977. *Comprehensive Plan for Medicine Bow, Wyoming*. Omaha, Nebraska.
- VAN VOAST, W.A., AND HEDGES, R.B., 1975. "Hydrologic Aspects of Existing and Proposed Strip Coal Mines Near Decker, Southeastern Montana" *Montana Bureau of Mines and Geology Bulletin* 97.
- VINE, J.D., AND PRICHARD, G.E., 1954. "Geology and Uranium Occurrence in the Miller Hill Area, Carbon County, Wyoming" *U.S. Geol. Survey Bull.* 1074-F 239 p.
- VTN, 1975. *Socioeconomic and Environmental Land Use Survey-Moffat, Routt and Rio Blanco Counties Colorado*. A summary report prepared for W.R. Grace & Co., Englewood, Colorado.
- WARBURTON, J.D., 1983. State Planning Engineer, Wyoming State Highway Department. Cheyenne, Wyoming. Personal Communication by Dave Cooper.
- WARDER, DONALD S., December 1979. *A Study of Recreation Use on Bureau of Land Management Lands in Southwestern and Southcentral Wyoming Coal Regions*, Final Report for BLM Contract YA-512-CT7-12. Department of Recreation and Park Administration, University of Wyoming.
- WARNER, J.W., and Dale, R.H. *Digital-Transport Model Study of the potential Effects of Coal-Resource Development on the Ground-Water System in the Yampa River Basin, Moffat and Routt Counties, Colorado*. Denver: U.S. Geological Survey Water Resources Investigations 81-15.
- WARNER, T.J., editor, 1976. *The Dominguez - Escalante Journal*. Brigham Young University Press, Provo, Utah.
- WATER AND POWER RESOURCE SERVICE, 1980. *Upper Colorado Resource Study, Colorado and Utah-Concluding Report Upper Colorado Regional Office, Salt Lake City, Utah*.
- WATER AND RELATED LAND RESOURCES WHITE RIVER BASIN IN COLORADO, 1966. Colorado Water Conservation Board and USDA.
- WATER RESOURCES COUNCIL, 1971. *Upper Colorado Region Comprehensive Framework Study* App. XV Water Quality Pollution Control and Health Factors.
- WEISZ, R., 1979. "Stress and Mental Health in a Boom Town" Davenport, Judith A. and Joseph, III, *Boom Towns and Human Services* pp. 31-47. University of Wyoming, Department of Social Work, University of Wyoming Publications, Vol XLIII, Laramie, Wyoming.
- WELDER, G.E., AND MCGREEVY, L.J., 1966. *Ground-Water Reconnaissance of the Great Divide and Washakie Basin and Some Adjacent Areas, Southwestern Wyoming*. U.S. Geol. Survey Hydrologic Invest., Atlas HA-219.
- WESTERN FUELS - Utah, 1980. Deserado Mine Mining Permit Application. Ford Bacon Dams and Utah, Inc.
- WILKINSON, Kenneth P., et al. "Western Energy Development and Rural Community Change: A Sociological Perspective." Paper presented at annual meeting of Rural Sociological Society, September, 1982.
- WILLIAMS, L.R., 1977. *Vandalism to Cultural Resources of the Rocky Mountain West MA Thesis*. Colorado State University, Ft. Collins, Colorado.
- WILLIAMS, N.M. and HUNN, E.S., editors, 1982. *Resource Managers: North American and Australian Hunter-Gatherers*. AAAS Selected Symposium 67 Westview Press, Inc.
- WILSON, M., editor, 1974. *Applied Geology and Archaeology: The Holocene History of Wyoming*. The Geological Survey of Wyoming Report of Investigations NO. 10.
- WINTORHOLDER, B. and Smith, E.A., editors, 1981 *Hunter-Gather Foraging Strategies*. The University of Chicago Press, Chicago.
- WOODBURY, A.M., 1947. "Distribution of Pigmy Conifers in Utah and N.W. Arizona" *Ecology* 28: 1947, pp. 113-126.
- WYOMING CROP AND LIVESTOCK REPORTING SERVICE, 1976. *Wyoming Agriculture Statistics*, University of Wyoming Experimental Station.
- WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY, 1981. *Alluvial Valley Floors: Land Quality Division Guideline NO. 9*.
- WYOMING DEPARTMENT OF HIGHWAYS, 1981. *Traffic*.
- WYOMING DEPARTMENT OF HIGHWAYS, 1981. *Accident Statistics*.
- WYOMING DEPARTMENT OF REVENUE AND TAXATION, 1982. *Annual Report 1981*. Cheyenne.
- WYOMING RECREATION COMMISSION, 1980. *State Comprehensive Outdoor Recreation Plan*.
- WYOMING RESOURCES CONSERVATION PLAN, VOL. II; *Resource Conservation Accomplishments and Future Goals*.
- WYOMING STATE LAND USE COMMISSION, 1979. *Wyoming State Land Use Plan* Cheyenne, Wyoming.
- WYOMING Taxpayers Association, 1982. *Wyoming Property Tax Rates 1982*. Cheyenne.
- WYOMING WATER DEVELOPMENT COMMISSION, 1981. *Current and Potential Water Demands, Green River Basin, Southwest Wyoming*, Second Draft.
- YOUNG, R.T. and JOHNSON, J., 1976. "Concept/Meeker" (Unpublished manuscript) Meeker, Colorado: Meeker Town Government.

#9906149

ID: 93074175 HD243.W8 G744 1993 C.2

WYC



BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

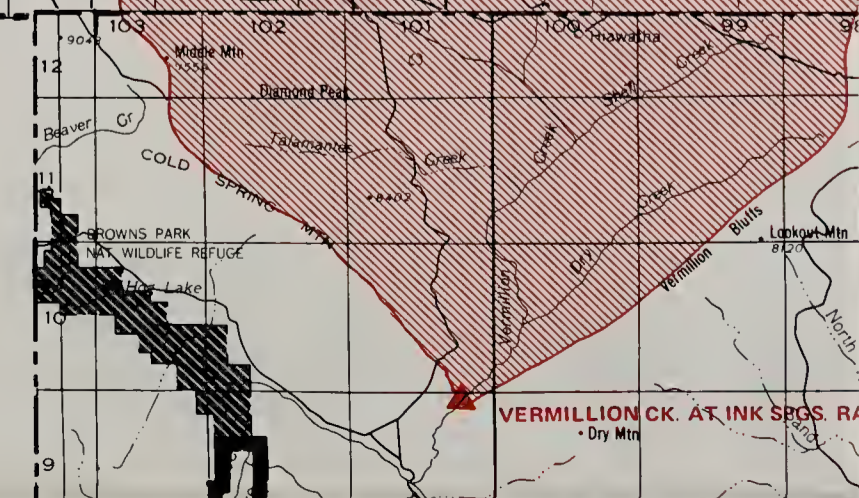
WYOMING

Ref. No.	COAL LEASES	Name of Mine	Lease No.
1	Kemmerer Coal Co.		W-075206
2	Kemmerer Coal Co.		W-060274
3	Kemmerer Coal Co.		W-056471
4	Kemmerer Coal Co.		W-0294513
5	Kemmerer Coal Co.		W-075207
6	Kemmerer Coal Co.	Elkol & Sorensen	W-055246

PREFERENCE RIGHT LEASE APPLICATIONS

Ref. No.	COAL LEASES	Name of Mine	Lease No.
46	Ark Land Co.		W-19188
47	Ark Land Co.		W-19187
48	Ark Land Co.		W-19190
49	Ark Land Co.		W-19189
50	Kemmerer Coal Co.		W-0324041
51	Kemmerer Coal Co.		W-0324042
52	Kemmerer Coal Co.		W-0324034
53	Kemmerer Coal Co.		W-0324037


Ref. No.	COAL LEASES	Name of Mine	Lease No.
98	Ferne M. James		C-064416
99	Utah International Inc.	Trapper Mine	C-813
100	Peabody Coal Co.		C-0114093
101	American Minority Mining Co.		C-29221
102	Materials Service Corp.	Seneca 2-W	C-081258
103	Materials Service Corp.	Seneca W-W	C-081251
104	Peabody Coal Co.	Seneca 2	C-19885
105	Colorado Yampa Coal Co.		C-22676



8	FMC Corp.	W-061421
9	Cumberland Coal Co.	W-060241
10	Peabody Coal Co.	W-0220486
11	Peabody Coal Co.	W-3438
12	Sweetwater Coal Development Co.	W-0313201
13	Stansbury Coal Co.	W-12793
14	Columbine Mining Co.	E-015155
15	Bridger Coal Co.	W-2728
16	Bridger Coal Co.	W-0313558
17	Bridger Coal Co.	W-2727
18	Black Butte Coal Co.	W-6266
19	Resource Development	W-092140
20	Resource Development	W-0313559
21	Resource Development	W-092141
22	Resource Development	W-0312917
23	Medicine Bow Coal Co.	W-72989
24	Medicine Bow Coal Co.	W-58095
25	Medicine Bow Coal Co.	W-42554
26	Ark Land Co.	W-16466
27	Energy Development Co.	W-16465
28	Ark Land Co.	W-054727
29	Ark Land Co.	W-054728
30	Rosebud Coal Sales Co.	C-057086
31	Ark Land Co.	W-054737
32	Ark Land Co.	C-078051
33	Capital Development Co.	W-72990
34	Ark Land Co.	C-033800
35	Rosebud Coal Sales Co.	W-48330
36	Ark Land Co.	W-49338
37	Ark Land Co.	W-0150169
38	Ark Land Co.	W-72991
39	Ark Land Co.	W-25406
40	Edison Development Co.	W-50061

45	China Butte	W-73096
----	-------------	---------

HYDROLOGY LEGEND

-  River Basin Boundary
-  Coal Area Drainages
-  Mountain Drainages

GREEN RIVER - HAMS FORK EIS COAL REGION

54	Kemmerer Coal Co.	W-0324035
55	Kemmerer Coal Co.	W-0324038
56	Kemmerer Coal Co.	W-0324036
57	Rosebud Coal Sales Co.	W-23411
58	Peabody Coal Co.	W-16431
59	Rosebud Coal Sales Co.	W-23412
60	Rosebud Coal Sales Co.	W-0308923

COLORADO

Ref. No.	COAL LEASES	Name of Mine	Lease No.
70	Reliable Coal & Mining Co.	Deserado	D-047201
71	Riebold & Chapman		C-028875
72	Utah International Inc.		C-07519
73	Utah International Inc.		C-0123475
74	Utah International Inc.		C-29225
75	Colowyo Coal Co.	Colowyo Strip	D-034365
76	Consolidated Coal Co.		C-29226
77	Consolidated Coal Co.		C-29224
78	Colorado Yampa Coal Co.	Energy No. 2 Strip	C-0128433
79	Consolidated Coal Co.		C-1546
80	Consolidated Coal Co.		C-093713
81	Northern Mineral Co.	Rienau No. 2	C-076713
82	Northern Mineral Co.		C-1545
83	Northern Mineral Co.	Northern No. 1,2,3	C-28358
84	Consolidated Coal Co.		C-093714
85	Northern Mineral Co.	Northern No. 1,2,3	C-28359
86	Consolidated Coal Co.		C-093715
87	Consolidated Coal Co.		C-093716
88	Northern Mineral Co.	Rienau No. 2	D-044240
89	Utah International Inc.		C-0123475
90	Empire Energy Corp.		C-30656
91	Empire Energy Corp.	Eagle No. 5 & 9	C-0126480
92	Utah International Inc.		C-25948
93	Empire Energy Corp.	Eagle No. 5	D-056298
94	Utah International Inc.	Trapper Mine	C-07518
95	Utah International Inc.	Trapper Mine	C-079641
96	W.R. Grace & Co.	Little Bear	C-0125957
97	Hayden Gulch West Coal Co.		C-29217

PROPOSED COAL LEASE TRACTS WYOMING

- A - Tract 98
- B - Byrne Creek
- C - Winton
- D - Leucite Hills
- E - Deadman
- F - Point of Rocks
- G - Pio
- H - Indian Springs
- I - Atlantic Rim
- J - NE Cow Creek
- K - Corral Canyon
- L - Wild Horse Draw

COLORADO

- N - Prairie Dog
- O - Rattlesnake
- P - Lay Creek
- Q - Signal Butte
- R - Peck Gulch(undrgrnd)
- S - Horse Gulch
- T - Bell Rock
- U - Iles Mountain
- V - Williams Fork
- W - Little Middle Creek
- X - Fish Creek
- Y - Middle Creek

106	Colorado Yampa Coal Co.
107	Colorado Yampa Coal Co.
108	Colorado Yampa Coal Co.
109	Colorado Yampa Coal Co.
110	Colorado Yampa Coal Co.
111	Colorado Yampa Coal Co.
112	Sunland Mining Corp.
113	Peabody Coal Co.
114	Peabody Coal Co.
115	Kemmerer Coal Co.
116	Kemmerer Coal Co.
117	AMCA Coal Leasing, Inc.
118	Kemmerer Coal Co.
119	Monolith Portland Midwest
120	Wyoming Fuel Co.
121	Kerr Coal Co.
122	Wyoming Fuel Co.
123	Ruby Construction Co.
124	Franklin Real Estate Co.
125	Prosper Lombardi, Jr.
126	Sheridan Enterprises Inc.
127	Sunland Mining Corp.
128	AMCA Coal Leasing, Inc.
129	Gulf Oil Corp.
130	Gulf Oil Corp.
131	Gulf Oil Corp.
132	Gulf Oil Corp.
141	Western Fuels Assoc.
142	Western Fuels Assoc.
143	Reliable Coal and Mining

PREFERENCE RIGHT LEASE APPLICATIONS

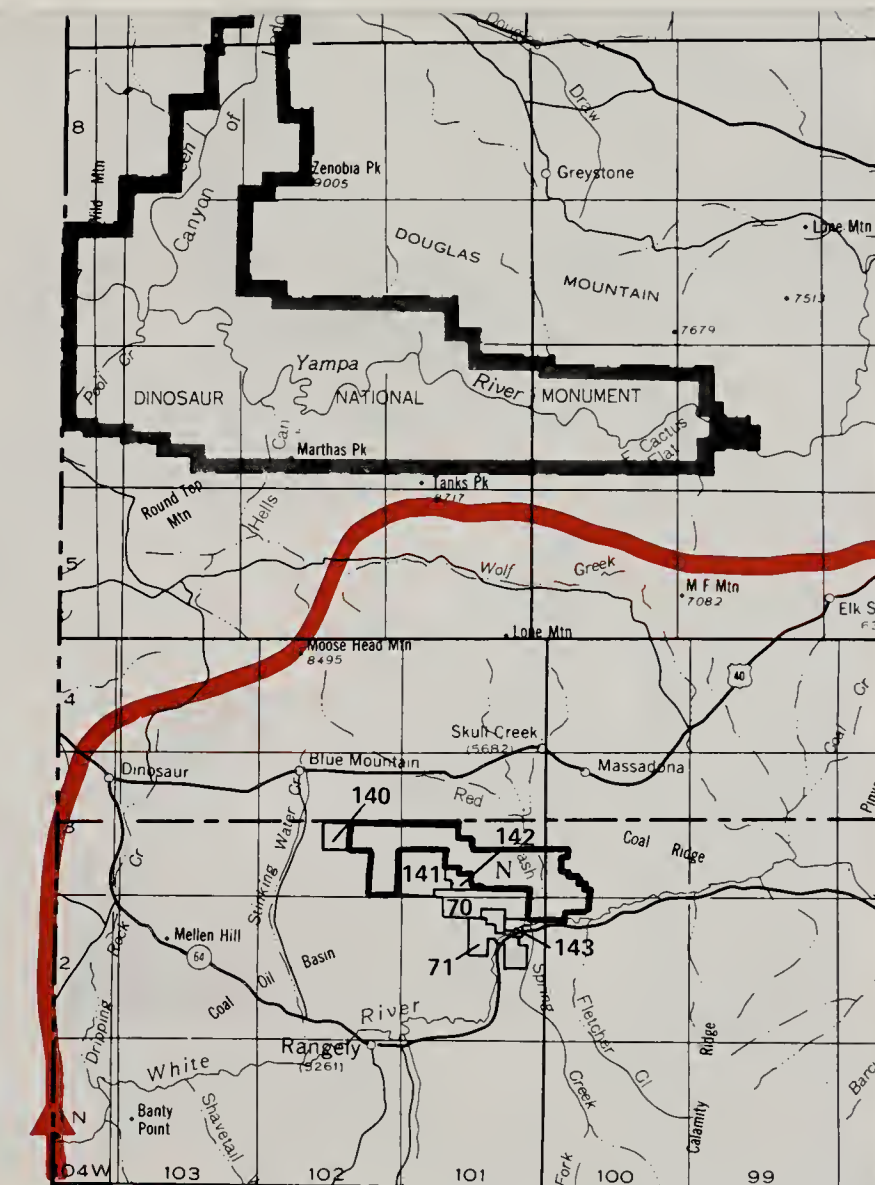
140	Riebold & Chapman	C-0125366
144	Northern Minerals Co.	C-0126997
145	Northern Minerals Co.	C-0126999
146	P. Jensen & K. W. Miller	C-4275
147	Consolidation Coal Co.	C-0126998
148	Kemmerer Coal Co.	C-0125854
149	Kemmerer Coal Co.	C-3606
150	Kemmerer Coal Co.	C-3605

Energy No. 2 Strip	C-20900
	C-29220
Energy No. 1 Strip	C-22644
Energy No. 1 Strip	C-081330
Energy No. 1 Strip	D-052547
Energy No. 1 Strip	C-16284
Apex No. 2	D-046544
Seneca No. 2	C-088199
	C-086654
	C-0123177
	C-0105299
	C-030472
	C-0105300
	D-057166
	C-31805
	C-22777
	C-29731
	D-051698
	C-012894
	C-23396
	C-052546
	C-0127592
	D-051376
	D-033327
	D-053710
	D-041478
	C-021601
	C-8424
	C-8425
	C-0126669

Canadian Strip Mine
Marr Strip No. 1
Canadian Strip Mine
Sun Mine
Cardinal

Joe's Mine
Apex No. 2

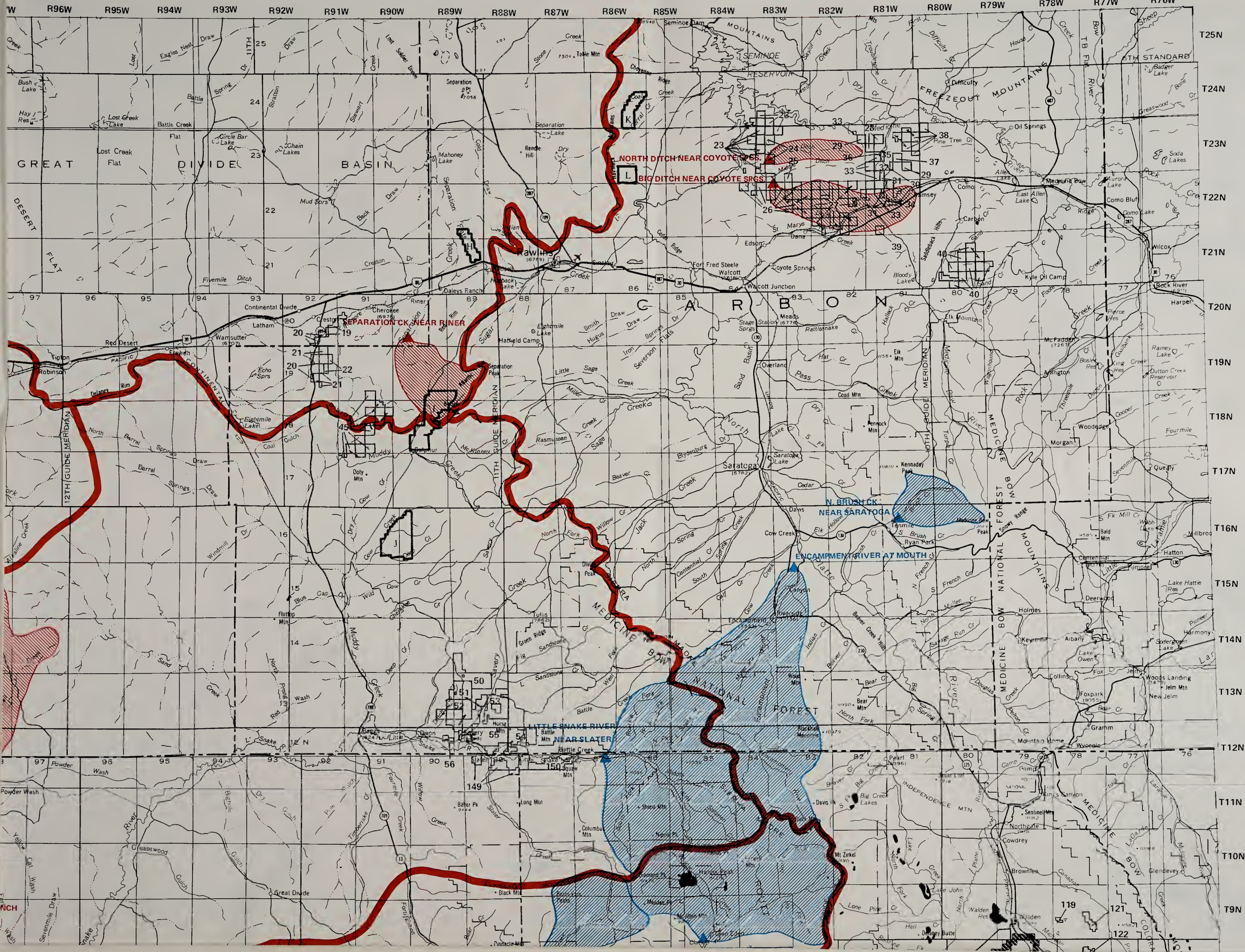
Edna
Edna
Edna
Edna

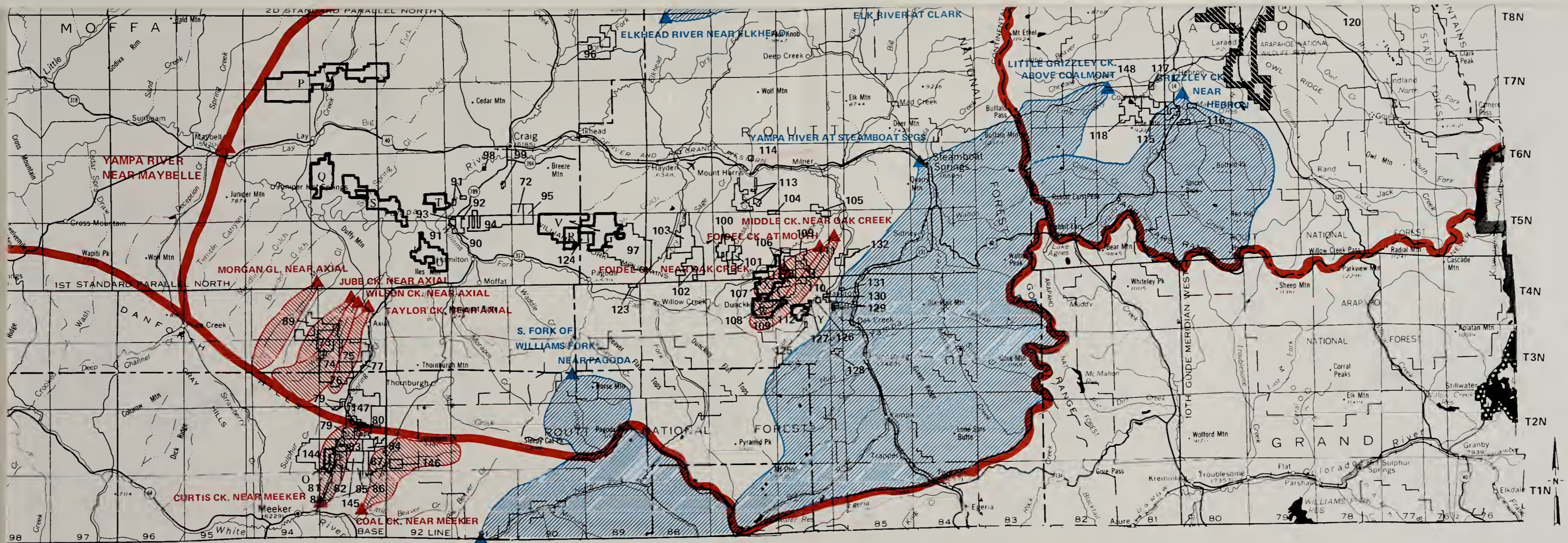


WHITE RIVER NEAR
CO/UT STATE LINE

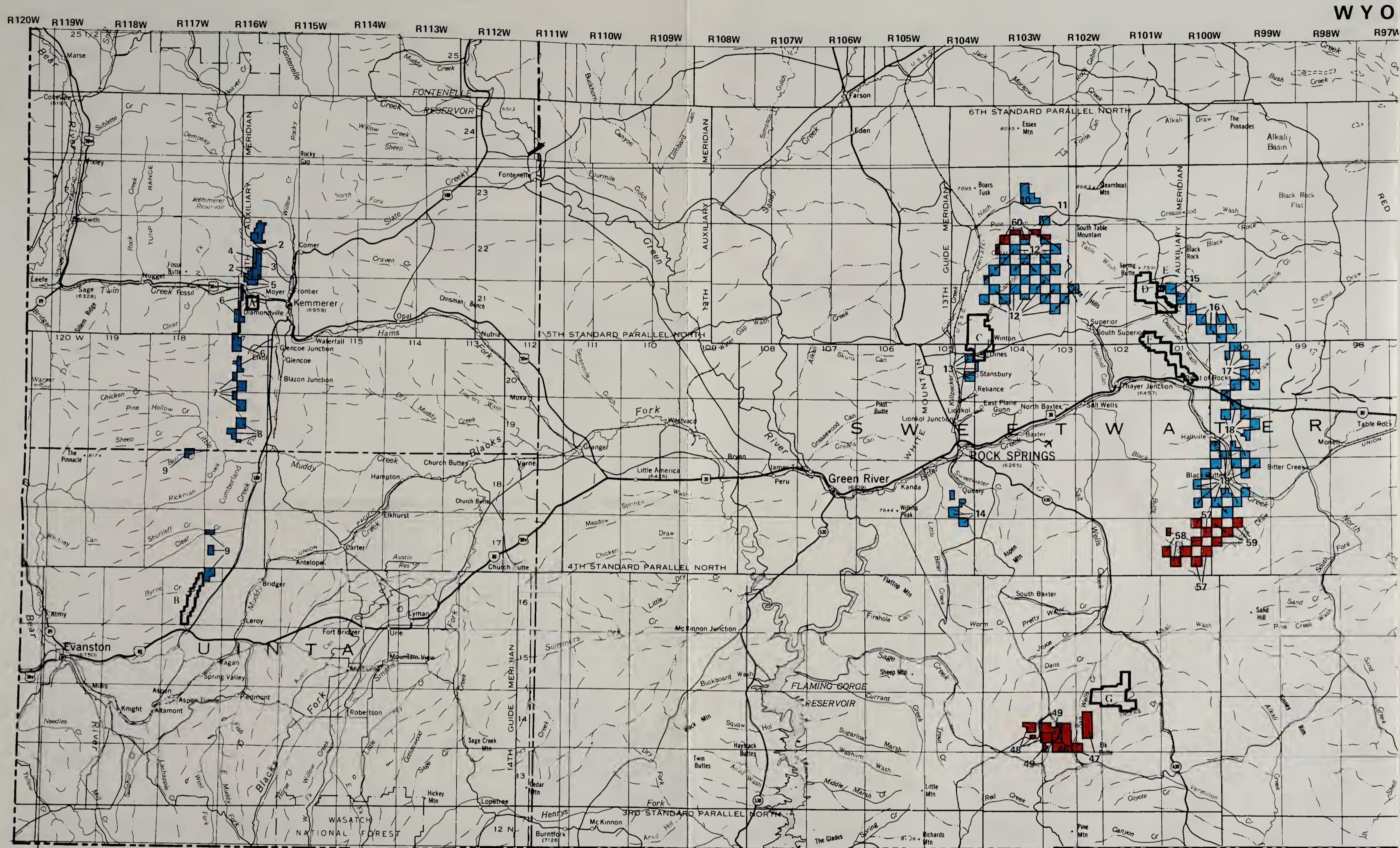
MINING

NORTH PLATTE RIVER
AT ORIN





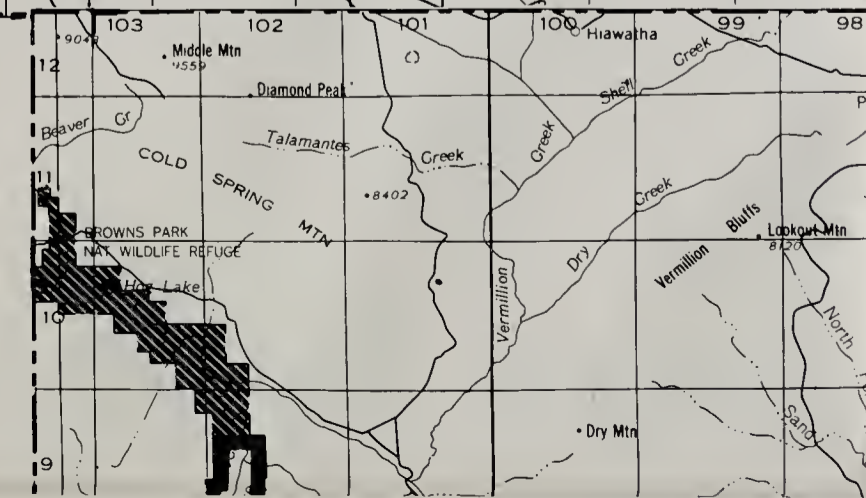
COLORADO



Ref. No.	COAL LEASES	Name of Mine	Lease No.
1	Kemmerer Coal Co.		W-075206
2	Kemmerer Coal Co.		W-060274
3	Kemmerer Coal Co.		W-056471
4	Kemmerer Coal Co.		W-0294513
5	Kemmerer Coal Co.		W-075207
6	Kemmerer Coal Co.	Elkol & Sorensen	W-055246

PREFERENCE RIGHT LEASE APPLICATIONS	
46	Ark Land Co.
47	Ark Land Co.
48	Ark Land Co.
49	Ark Land Co.
50	Kemmerer Coal Co.
51	Kemmerer Coal Co.
52	Kemmerer Coal Co.

Ref. No.	COAL LEASES	Name of Mine	Lease No.
98	Ferne M. James		C-064416
99	Utah International Inc.	Trapper Mine	C-813
100	Peabody Coal Co.		C-0114093
101	American Minority Mining Co.		C-29221
102	Materials Service Corp.	Seneca 2-W	C-081258
103	Materials Service Corp.	Seneca W-W	C-081251
104	Peabody Coal Co.	Seneca 2	C-19885



7	FMC Corp.	W-061422
8	FMC Corp.	W-061421
9	Cumberland Coal Co.	W-060241
10	Peabody Coal Co.	W-0220486
11	Peabody Coal Co.	W-3438
12	Sweetwater Coal Development Co.	W-0313201
13	Stansbury Coal Co.	W-12793
14	Columbine Mining Co.	E-015155
15	Bridger Coal Co.	W-2728
16	Bridger Coal Co.	W-0313558
17	Bridger Coal Co.	W-2727
18	Black Butte Coal Co.	W-6266
19	Resource Development	W-092140
20	Resource Development	W-0313559
21	Resource Development	W-092141
22	Resource Development	W-0312917
23	Medicine Bow Coal Co.	W-72989
24	Medicine Bow Coal Co.	W-58095
25	Medicine Bow Coal Co.	W-42554
26	Ark Land Co.	W-16466
27	Energy Development Co.	W-16465
28	Ark Land Co.	W-054727
29	Ark Land Co.	W-054728
30	Rosebud Coal Sales Co.	C-057086
31	Ark Land Co.	W-054737
32	Ark Land Co.	C-078051
33	Capital Development Co.	W-72990
34	Ark Land Co.	C-033800
35	Rosebud Coal Sales Co.	W-48330
36	Ark Land Co.	W-49338
37	Ark Land Co.	W-0150169
38	Ark Land Co.	W-72991
39	Ark Land Co.	W-25406
40	Edison Development Co.	W-50061

LEASE APPLICATION



45	China Butte	W-73096
----	-------------	---------

53	Kemmerer Coal Co.	W-0324037
54	Kemmerer Coal Co.	W-0324035
55	Kemmerer Coal Co.	W-0324038
56	Kemmerer Coal Co.	W-0324036
57	Rosebud Coal Sales Co.	W-23411
58	Peabody Coal Co.	W-16431
59	Rosebud Coal Sales Co.	W-23412
60	Rosebud Coal Sales Co.	W-0308923

COLORADO

Ref. No.	COAL LEASES	Name of Mine	Lease No.
70	Reliable Coal & Mining Co.	Deserado	D-047201
71	Riebold & Chapman		C-028875
72	Utah International Inc.		C-07519
73	Utah International Inc.		C-0123475
74	Utah International Inc.		C-29225
75	Colowyo Coal Co.	Colowyo Strip	D-034365
76	Consolidated Land Development		C-29226
77	Consolidated Coal Co.		C-29224
78	Colorado Yampa Coal Co.	Energy No. 2 Strip	C-0128433
79	Consolidated Coal Co.		C-1546
80	Consolidated Coal Co.		C-093713
81	Northern Mineral Co.	Rienau No. 2	C-076713
82	Northern Mineral Co.		C-1545
83	Northern Mineral Co.	Northern No. 1,2,3	C-28358
84	Consolidated Coal Co.		C-093714
85	Northern Mineral Co.	Northern No. 1,2,3	C-28359
86	Consolidated Coal Co.		C-093715
87	Consolidated Coal Co.		C-093716
88	Northern Mineral Co.	Rienau No. 2	D-044240
89	Utah International Inc.		C-0123475
90	Empire Energy Corp.		C-30656
91	Empire Energy Corp.	Eagle No. 5 & 9	C-0126480
92	Utah International Inc.		C-25948
93	Empire Energy Corp.	Eagle No. 5	D-056298
94	Utah International Inc.	Trapper Mine	C-07518
95	Utah International Inc.	Trapper Mine	C-079641
96	W.R. Grace & Co.	Little Bear	C-0125957
97	Hayden Gulch West Coal Co.		C-29217

PROPOSED COAL LEASE TRACTS

WYOMING

A - Tract 98
B - Byrne Creek
C - Winton
D - Leucite Hills
E - Deadman
F - Point of Rocks
G - Pio
H - Indian Springs
I - Atlantic Rim
J - NE Cow Creek
K - Corral Canyon
L - Wild Horse Draw

COLORADO

N - Prairie Dog
O - Rattlesnake
P - Lay Creek
Q - Signal Butte
R - Peck Gulch(undgrnd)
S - Horse Gulch
T - Bell Rock
U - Iles Mountain
V - Williams Fork
W - Little Middle Creek
X - Fish Creek
Y - Middle Creek

103	Colorado Yampa Coal Co.	C-22070
106	Colorado Yampa Coal Co.	C-20900
107	Colorado Yampa Coal Co.	C-29220
108	Colorado Yampa Coal Co.	C-22644
109	Colorado Yampa Coal Co.	C-081330
110	Colorado Yampa Coal Co.	D-052547
111	Colorado Yampa Coal Co.	C-16284
112	Sunland Mining Corp.	D-046544
113	Peabody Coal Co.	C-088199
114	Peabody Coal Co.	C-086654
115	Kemmerer Coal Co.	C-0123177
116	Kemmerer Coal Co.	C-0105299
117	AMCA Coal Leasing, Inc.	C-030472
118	Kemmerer Coal Co.	C-0105300
119	Monolith Portland Midwest	D-057166
120	Wyoming Fuel Co.	C-31805
121	Kerr Coal Co.	C-22777
122	Wyoming Fuel Co.	C-29731
123	Ruby Construction Co.	D-051698
124	Franklin Real Estate Co.	C-012894
125	Prosper Lombardi, Jr.	C-23396
126	Sheridan Enterprises Inc.	C-052546
127	Sunland Mining Corp.	C-0127592
128	AMCA Coal Leasing, Inc.	D-051376
129	Gulf Oil Corp.	D-033327
130	Gulf Oil Corp.	D-053710
131	Gulf Oil Corp.	D-041478
132	Gulf Oil Corp.	C-021601
141	Western Fuels Assoc.	C-8424
142	Western Fuels Assoc.	C-8425
143	Reliable Coal and Mining	C-0126669

PREFERENCE RIGHT LEASE APPLICATIONS

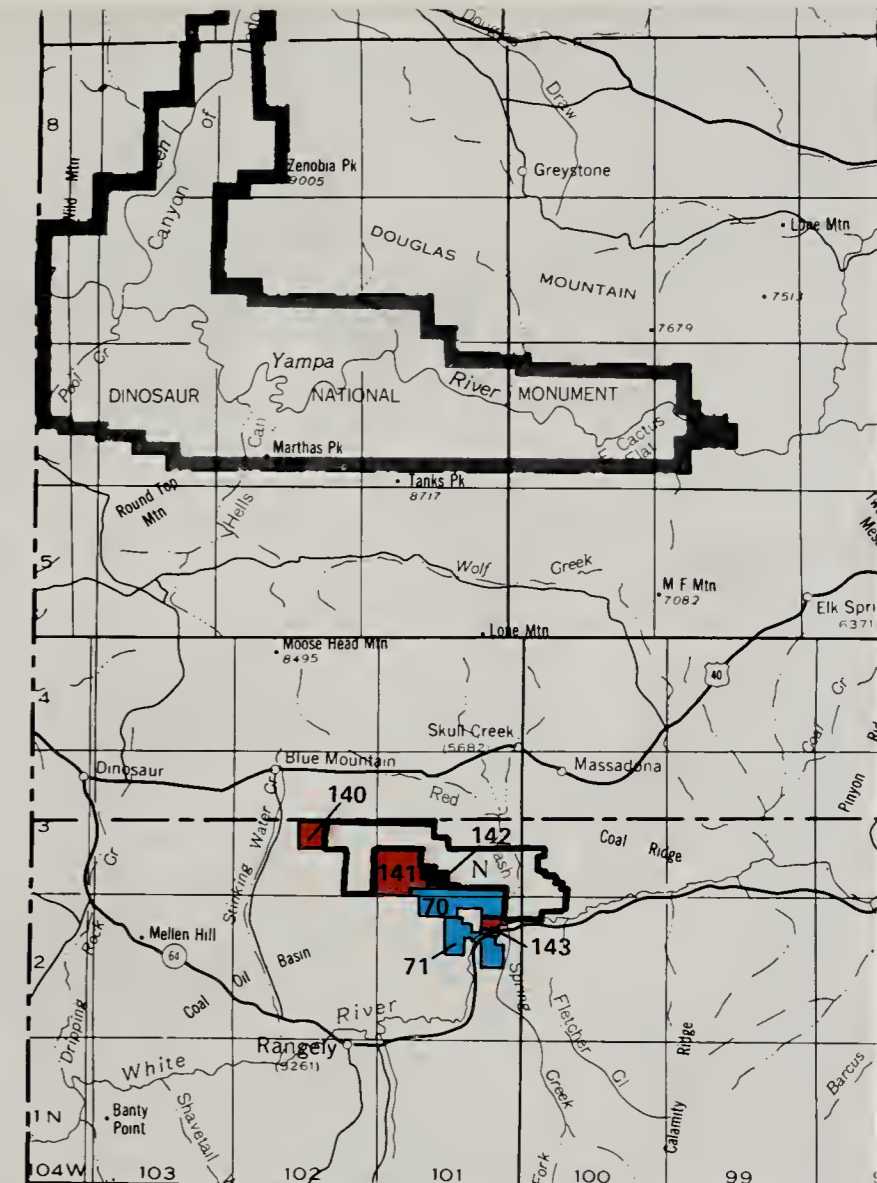
140	Riebold & Chapman	C-0125366
144	Northern Minerals Co.	C-0126997
145	Northern Minerals Co.	C-0126999
146	P. Jensen & K. W. Miller	C-4275
147	Consolidation Coal Co.	C-0126998
148	Kemmerer Coal Co.	C-0125854
149	Kemmerer Coal Co.	C-3606
150	Kemmerer Coal Co.	C-3605

Energy No. 2 Strip
Energy No. 1 Strip
Energy No. 1 Strip
Energy No. 1 Strip
Apex No. 2
Seneca No. 2

Canadian Strip Mine
Marr Strip No. 1
Canadian Strip Mine
Sun Mine
Cardinal

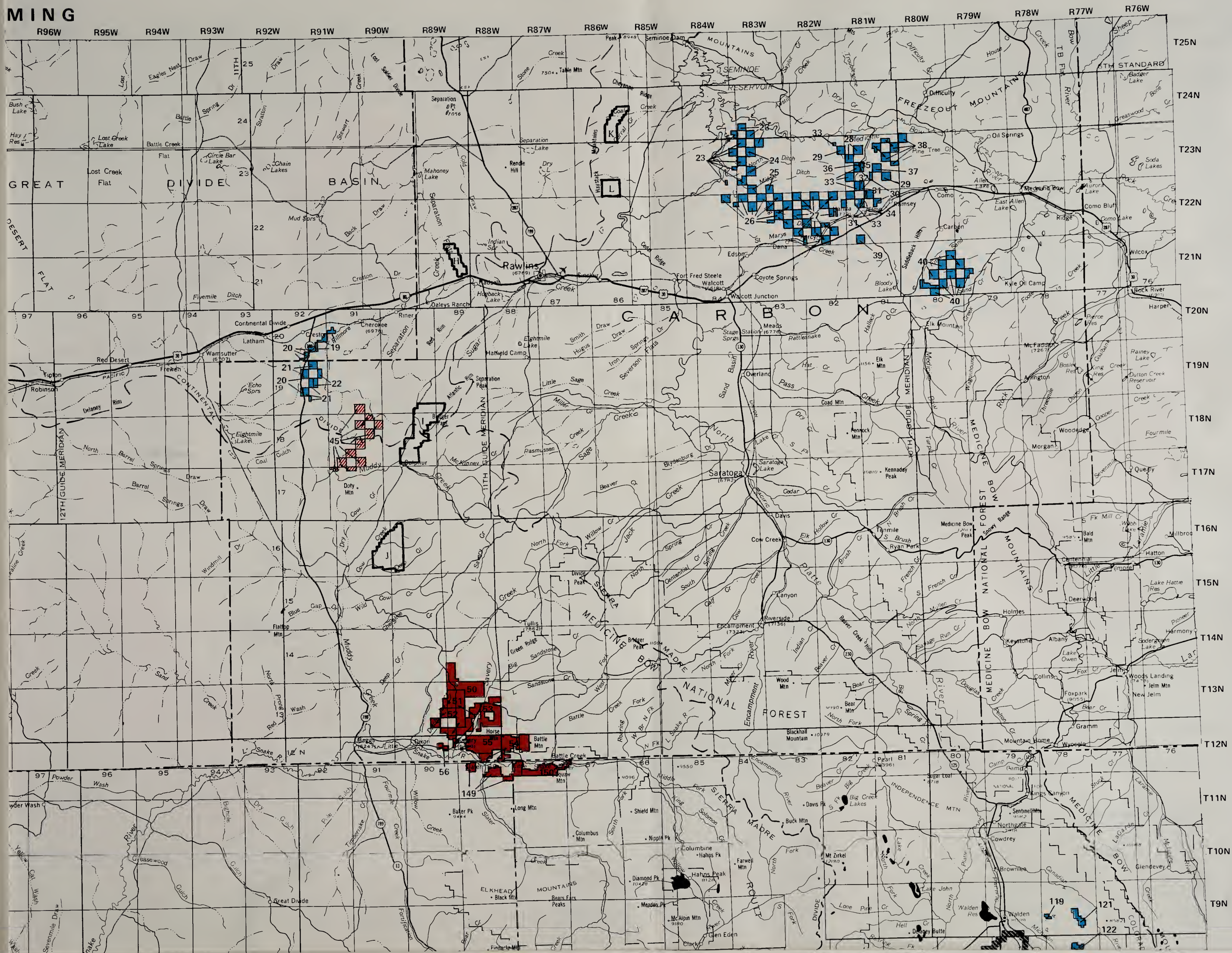
Joe's Mine
Apex No. 2

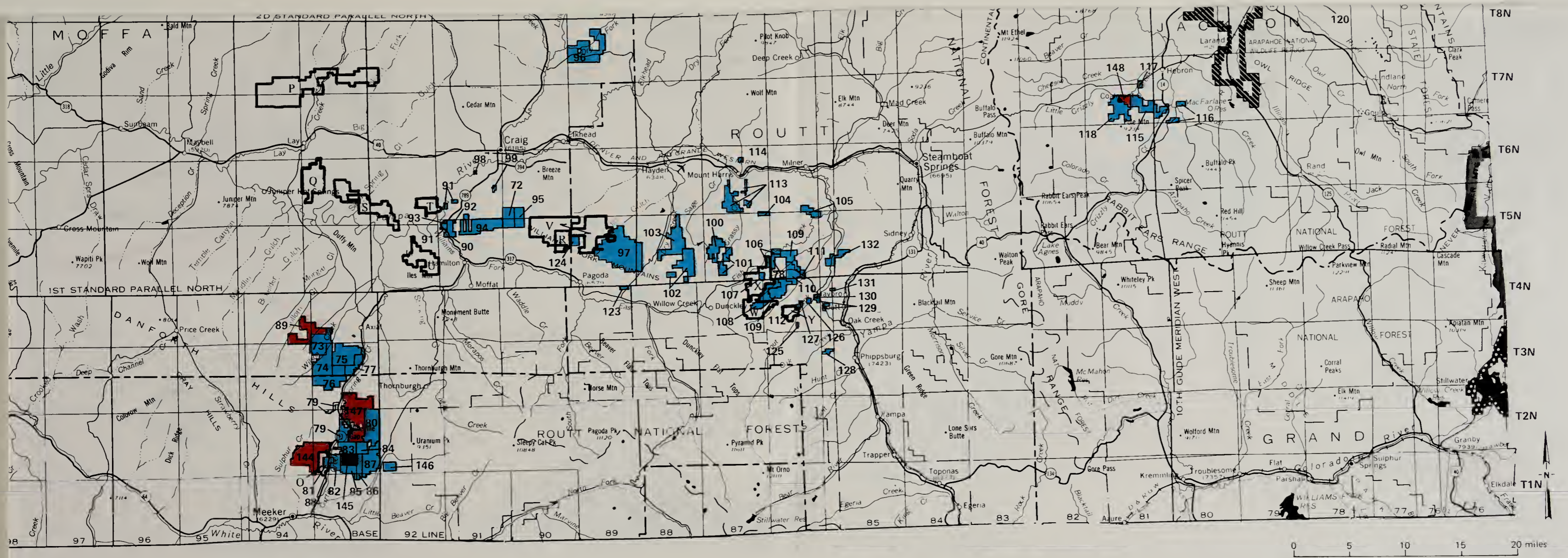
Edna
Edna
Edna
Edna



GREEN RIVER - HAMS FORK EIS COAL REGION

M I N G





COLORADO

BLM Library
Denver Federal Center
Bldg. 50, OC-521
P.O. Box 25047
Denver, CO 80225

